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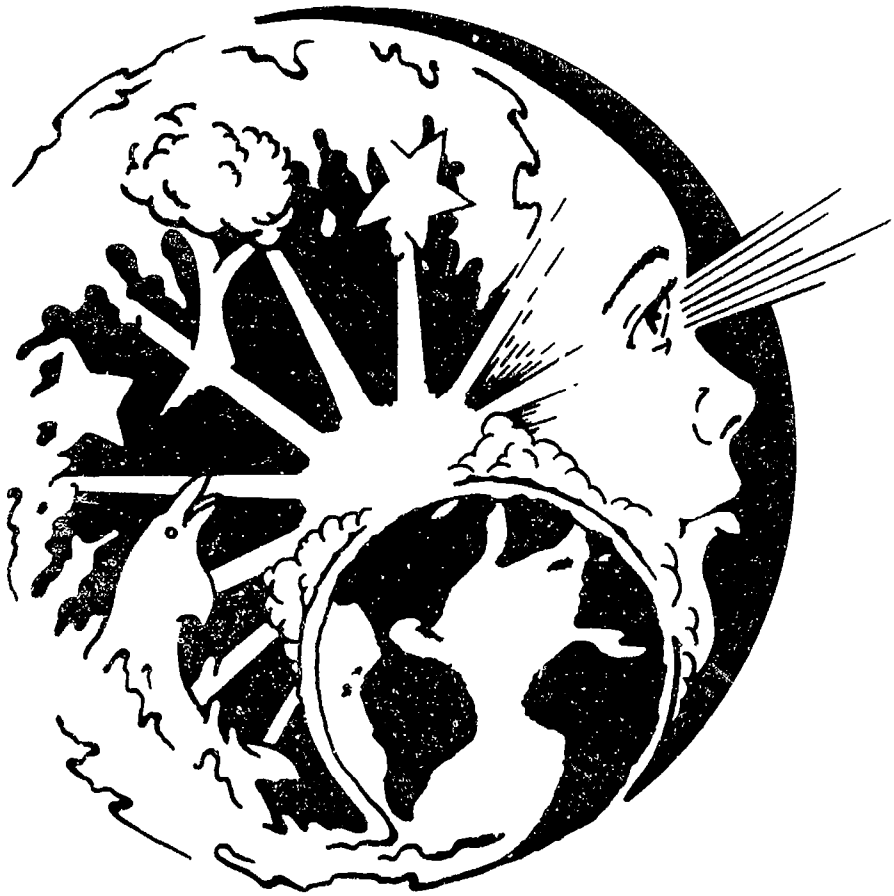
ABSTRACT

An understanding of the environment and peoples' role in its preservation and destruction must be acquired in order to circumvent the current threat of environmental deterioration. This document provides lessons developed to help students and others reconnect with the natural systems which sustain life. The following activities are provided for studying the life cycle of a variety of objects: (1) "Rita Rubberband Returns to the Rain Forest"; (2) "A Long Way to Lunch" (school lunch); (3) Chipping Away at the Forests" (paper); (4) "To Flush or not to Flush, That is the Question"; (5) "How to Dress a Dinosaur: From Oil, to Yogurt, To...?" (yogurt container); (6) "Zap! Goes the Ozone!"; (7) "Battery Bugaboo Boogie"; (8) "A T-Shirt Talks"; (9) "It's Not Really Horsepower Anymore -or- There's a Dinosaur Driving Down the Street" (gasoline); and (10) "A Juicy Case: Aseptic Packaging v. the Environmentalists." Activities typically take from 2-3 30-45 minute class periods. The following information is provided for each activity: subjects addressed (e.g., social studies, science, art, math, etc.); appropriate grade level (most are for intermediate grades); academic skills used (e.g., classification, critical thinking, psychomotor, etc.); time required to complete; materials needed; vocabulary; concepts; activity objective; and background information for the teacher. (ZWH)



CONNECTIONS

Life Cycle Kinesthetic Learning

In this age of magic, when every conceivable "need" is as close as the store shelf, inside a block and steel building, and surrounded by concrete and pavement, very few children ask the following question. The question is: "Daddy, Mommy, where did this come from?"

Herein lies the secret to the deeper problem at hand. The environment is deteriorating because we have forgotten where everything comes from; and we take for granted that the status quo will always continue. Meanwhile the skies darken, the waters become unclean and the deserts sprawl.

> *"We will protect only what we love; we will love only what we understand; and we will understand only what we are taught."*
>
> Baba Dioum (Senegal)

To make environmental learning relevant, students must understand their responsibility and their place in the life cycles of the things they use everyday. In a small way, these "Life Cycle Kinesthetic Learning" lessons may play a part in the reconnection of ourselves and our youth to the natural systems which sustain us.

Lida A. Lynn

In infancy and early childhood there is a universal mode of learning which is called play. It appears naturally as children reach out to explore and imitate the world around them. While playing games as simple as "peek-a-boo" and "patty cake" children are stimulated on many different levels. Physically there is improvement in eye-hand coordination; mentally, the development of object permanence is enhanced; and socially, the child learns to interact with others. From the joyful pleasure of play, children derive a myriad of skills that they will continue to develop throughout their lives.

In each of these lesson plans, there is at least one element of play. From high energy outdoor games to dance, pantomime and simple experiments, we have included a variety of activities that engage the body as well as the mind. It is our premise that when a child is playing rather than working, learning is natural and fun. We also believe that with lessons which simultaneously embrace all modes of learning - visual, auditory, kinesthetic and tactile - actual behavior change can be embodied quickly.

We hope you will enjoy participating in these lesson plans as much as we have.

Charlotte Nick-Walker

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CONTENTS

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Dedicated to Virginia Dannels,
whose vision allowed this project to come to fruition.

"RITA RUBBERBAND RETURNS TO THE RAINFOREST"

The Life Cycle of a Rubber Band

"RITA RUBBERBAND RETURNS TO THE RAIN FOREST"

SUBJECTS: Social Studies, Science, Art, Math, Movement Exploration, Geography, Language Arts

GRADES: 1-3

ACADEMIC SKILLS: Classification, critical thinking, discussion, drawing, inference, kinesthetic concept development, listening, listing, problem solving, psychomotor, synthesis

TIME: Two or three 30-minute class periods

MATERIALS: Book making supplies, pre-captioned pages (optional), laminate material, box of rubber products (balloon, rubber gloves, bicycle tire, eraser, foam rubber balls, rubber cement, gloves, hoses, shoes, etc.) rubber bands of different sizes, pictures of deforestation, pictures of a healthy rain forest, food from "The Jungle Pantry" list.

VOCABULARY: Renewable, reserve, rubber, preserve, conserve, landfill, canopy, latex

CONCEPT: Natural rain forests contain a myriad of valuable life forms, and support numerous indigenous peoples. Rain forests are being destroyed for short-term economic gain and to satisfy the world demand for commodities such as exotic hardwoods, pulp for paper and grazing land for cattle. By the year 2050, all the remaining rain forests may be gone.(5)

One of the most effective ways to save the rain forests may be to search out and utilize renewable rain forest commodities, making it more economically advantageous to save the rain forests than to cut them down. One resource that can be harvested with a minimal amount of damage is rubber.

OBJECTIVE: Students will understand the benefits gained through careful harvesting of renewable resources by following Rita Rubberband as she returns home to the rain forest for a visit. Students will perform movement exercises, and will make a story book entitled "Rita Returns to the Rain Forest", to illustrate the concepts above.

BACKGROUND: (See attached.)

ACTIVITIES:

Classroom Preparation

Movement and art activities are key elements in this project. Please read the lesson plan thoroughly before beginning and arrange adequate space for all the activities.

Brainstorming Session

Ask students to suggest ways in which rubber bands are used (around newspapers, in hair, with braces, etc.) List these on the chalk board. Make another list including other items which have rubber in them. After the children have shared their ideas, show examples from the materials you have brought in.

Ask the children about their ideas of how rubber is unique, (i.e. because of its ability to stretch, hold air and be waterproof). To demonstrate, take a balloon out of the box and blow it up.

Pass out rubber bands to the students. Ask the students to stretch their rubber bands and think of the ways their bodies also stretch. As a group take five minutes to stretch as many different ways as possible. Then tell the children that this lesson is also going to stretch their imaginations and take them to faraway places where rubber trees grow in rain forests.

Geography

Tell the children that rubber trees grow in tropical rain forests and on rubber plantations in tropical regions. Using a globe, show the children where rubber trees are grown (Malaysia, Thailand, Indonesia, Sri Lanka, India, Liberia, Nigeria and the Amazon Jungle(4)). Tell the children that the next activity is going to be about a rubber band named Rita, who returns home to the Amazon Jungle rain forest.

Book Making and Story Activity

During this book making activity, the teacher will read the following story (shown in italics) which is interrupted by a variety of movement and drawing activities. Depending on the grade level, you may choose to hand out pre-captioned pages for each student, or ask them to write the captions under their own pictures. Older children can create their own captions. Arrange the room as a large open space where children can move and draw on the floor.

THE ADVENTURE BEGINS: "RITA RETURNS TO THE RAIN FOREST"

Close your eyes and imagine a rubber band named Rita. Rita lives in the United States in a landfill. She arrived there after someone took her off a Sunday newspaper and threw her in the trash.

Ask the children to draw a picture of Rita at the landfill as you begin to tell them Rita's story. **(Caption #1: Rita the Rubber Band at the Landfill)**

One day while laying around in the rubbish, Rita began to think of her life. She thought back to the forest and the Great Rubber Tree she had come from. Rita began to miss the rain forest and all of her old friends. She decided to return home for a visit.

Once again show the children the globe or a map and ask them to think of ways Rita might have to travel to get to the rain forest (car, train, plane, boat). This time ask them to draw a picture of Rita on her way to the rain forest. **(Caption #2: Rita Travels Home to the Rain Forest)**

As Rita is traveling, she passes a rain forest which had been burned down. She knew that it had been burned down to make open land for cattle grazing. But now, there weren't even cows there, because all the soil had washed away, and nothing would grow for the cows to eat. She knew her home wouldn't look like this because it was a special place called a reserve. The government said reserves can't be cut down or burned up. Rita was glad that her home was safe, but she feels sad when she thinks of all the plants and animals that were destroyed in this forest.

Show the children some pictures of deforestation. Draw a picture of Rita's sad face. **(Caption #3: The Forest Had Been Destroyed)**

After many days of travel, Rita arrives at her own lovely rain forest. As she enters the forest, she sees how dark and shaded the ground is from the tall canopy of trees. Everywhere she looks there is a different kind of tree! It is so different than the landfill! There, the sky was all blue with just a few kinds of trees here and there. When you look up in the rainforest, it's almost pure green with just a few patches of blue sky here and there!

Rita couldn't believe her ears! She had forgotten what noisy places rain forests are! Thousands of birds, animals and insects are squawking, talking and chattering at once! It is much noisier than the landfill ever gets!

Ask the children what noises they think she is hearing. Show them pictures of a healthy rain forest. Ask the children to draw a noisy animal for their story book. **(Caption #4: Noisy Critters in the Rain forest)**

There are strong smells in her rain forest! Rita takes a deep breath and smells all the wonderful fruits and flowers. Even the ground smells like deep, rich earth. Rita remembered what yummy foods originated from her home, even chocolate! All the rich smells make her hungry! She picks some bananas, cashew nuts, oranges and pineapples and sits down to have a picnic. Just as she is about to start eating, she hears a stirring in the trees. Mixed in with all the laughter of the birds and insects is the voice of her old friend, MANGO THE MONKEY.

Ask the children to imitate the sounds they think MANGO might make. Then ask them to draw a picture of a food item that originated in the rain forest. **(Caption #5: Rain Forest Food)**

Just then another old friend SANTIAGO THE SNAKE slithers up to join them. And look! Flying through the air like a beautiful flower is BELIZE THE BUTTERFLY! Every one is so happy to see each other and to join the picnic. While Rita and her friends are eating and telling stories, it begins to rain. Rainy weather never ruins a picnic in the rain forest because every one is used to it. Laughing, Rita and her friends run to be under a huge tree with wonderful umbrella leaves that protect them from the rain.

(NOTE TO THE TEACHER: The following activity will encourage active student involvement in the story.)

Rhythm and Movement Activity: Rain in the Classroom

Instruct the children to sit in a circle, facing the center. Offer them a snack from some food that originated in the rain forest. Explain that lots of things that we have in the home, originally came from the rain forest. (See "Jungle in the Pantry" for a list.) Ask the children to pretend they are having a snack with Rita. When they are done, say, *Let's pretend we are in the rain forest and play a rain game!*

Ask them to quiet their voices to whispers and to do what you do. Begin the rain storm by rubbing the palms of your hands together and say *A little wind and drizzle has started.* After a short time of this sound, begin snapping one finger slowly or tapping two fingers together. (Some children won't be able to snap their fingers.) *Here come the rain drops, dripping off the tall, tall trees!* Then snap or tap more quickly. Add another finger, snapping or tapping faster. *Here come more drops and they're getting bigger and faster!* Start clapping your hands quickly and then gradually begin slapping your legs using your hands alternately...AND THEN SAY *OH NO! A CLOUDBURST!* Add stomping your feet as loudly as you can.

Reverse this process as the rain storm goes away--slap your legs, clap your hands, snap or tap your fingers quickly, then more slowly. End by rubbing the palms of your hands together.

(NOTE: A more complicated version of this game is to have the children follow the leader, each in turn, "passing" the action around the circle. Keep up the action as it is passed until the leader begins the next action and pass it around the circle.)

After the snack and rain game, ask the children to draw a picture of themselves and Rita having a picnic in the rain forest. **(Caption #6: Rita and I Have a Picnic)**

> **(NOTE TO THE TEACHER: This is a good place to break for lunch or for the day. If so, you may want to start the next class period with the extension exercise called "Follow The Jungle Critter.")**

After the picnic, Rita waves good-bye to her friends as she journeys to the rubber tree reserve. There she meets her friend, Kiwi. Kiwi is a barefoot boy who has lived his whole life in the rain forest. He is going to see his father whose work is to collect latex from rubber trees which is made into rubber. Rita and Kiwi watch his father work. First he cuts a narrow groove about halfway around the tree. Latex oozes from the groove into a small cup. When the cup is full, Kiwi's father empties it into a large bucket. Kiwi and Rita are glad that taking latex from the trees to make rubber does not harm the trees.

Ask the children about the work their parents do. Invite them to share their ideas about why people work. Explain that in the United States there are many more kinds of jobs than in the rain forest. Ask the children what would happen to Kiwi's father's work if the whole rubber tree reserve had been cut down or burned. Ask the children to draw a picture of Kiwi's father working. **(Caption #7: Kiwi's Father Working)**

Kiwi asks his father if he and Rita can make "cahuchu" (CA-HOO-CHOO) shoes. Kiwi's father smiles and nods, lifting the bucket down from the tap in the tree. Rita and Kiwi carefully dip their feet in the bucket, coating them in the rubber. After it dries, they can play in the forest and keep their feet dry!

Ask the children to draw a picture of Kiwi and Rita dipping their feet in a bucket of latex. **(Caption #8: Rita and Kiwi Make CAHUCHU Shoes)**

Rita and Kiwi run through the reserve until they come to the Great Rubber Tree that Rita was made from. Rita wraps herself around the tree and gives it a great big rubber band hug. The tree is warm and happy! (Ask the children to give themselves a great big hug.)

After her day full of play, Rita lays down and begins to think about her friends back at the landfill in the United States.

Ask the children what happens next? First discuss all of their ideas and then ask them to draw a picture to finish the story. **(Caption #9: What Happens Next?)**

Discussion Questions

1. What becomes of rubber that is thrown away?

2. Are the rubber reserves good for the rain forests?

3. What part do you play in the life cycle of this tiny little object which affects the whole world? Did you know that every little thing you touch is part of the whole earth and affects its health?

EXTENSIONS:

1. **Follow The Jungle Critter Game**

Ask the children to imitate Rita and her friends as they play her favorite game, "Follow The Jungle Critter." Choose three students to play the parts of Rita's friends, MANGO THE MONKEY, SANTIAGO THE SNAKE and BELIZE THE BUTTERFLY. Say to the students:

Rita's rain forest friends will take turns leading the game. First, MANGO THE MONKEY, show everyone how to swing their arms while running around. Then SANTIAGO THE SNAKE show us how to slither around on the forest floor by stretching out and then coiling up. BELIZE THE BUTTERFLY, show us how to fly from flower to flower, by flapping our wings.

Once the children have completed their movements, ask them to draw a picture of themselves and the forest creatures playing "Follow The Jungle Critter." Add it to their story book. **(Optional Caption: Follow The Jungle Critter)**

2. **Science: Making a rubber band** (adapted from The Big Stretch)

Materials: Dandelions or milkweed plants
A spoon or tiny container
Your finger

You may want to use milkweed plants because the leaves and seed pods, as well as the stem, contain latex. Dandelions will also work, but they do not produce as much latex per plant.

Break the stem of the plant and let the latex drip onto the spoon or into the small container. Cover your finger with the latex, down to the first knuckle. Hold your hand flat so it dries evenly.

It will take 10 to 15 minutes for the latex to change into a rubbery band. While waiting for the latex to dry, it would be a good time to read a story to the students from one of the books listed in the resource section.

Explain that the heat generated by your finger helps produce the rubbery band. The heat causes the water in the latex to evaporate. The color of the substance on your finger will begin to change. When the colorless substance has completely dried, roll it slowly and evenly from the knuckle toward the tip of your finger. Your rubber band is fragile, so pull gently.

3. **Math: How many rubber bands are there in a pound?**

Materials: Examples of items weighing one pound
Scale or some form of measuring one pound
2,500 rubber bands

(Adaptation: If one pound and 2,500 are too large for first or second graders, change to one ounce.)

Discuss what one pound is, listing students' ideas. Have examples available for the students to hold and examine. Estimate the number of rubber bands it would take to weigh one pound. (This needs to be a whole class activity because of the number of rubber bands needed.)

Without counting, collect rubber bands on a scale until they weigh one pound. Then divide the class into small groups and give each group some of the rubber bands. In their groups they are to estimate, then count the total number. Compare their estimates with the actual count. Calculate the difference and share results with the group.

Then find the number of rubber bands that equal one yard vhen laid end to end.

4. **Critical Thinking: How can we reuse rubber bands?**

Brainstorm and ist ideas from students. Act on any appropriate ideas (i.e. writing letters to local post offices and newspapers to suggest reuse of rubber bands, returning rubber bands to the newspaper carrier, etc.)

BACKGROUND INFORMATION:

Rubber is one of our most important raw materials. It holds air, is waterproof, does not conduct electricity; and most importantly, it is elastic. It is one of our few raw materials that would be almost impossible to get along without. Natural rubber is made from the latex found in rubber trees with added chemicals. Synthetic rubber is made entirely from chemicals.(2)

Approximately 40,000 to 50,000 different products are made from rubber. Three-fifths of all rubber is used in tires and tubes. One-tenth is used for machinery belts, gaskets, seals, and printing rollers. In addition, rubber is used for waterproof aprons, boots, raincoats and hats; and for hair combs, hot water bottles, shoe soles, surgeons' gloves, syringes, elastic tape; all kinds of balls, toys, foam rubber products, rubber cement; and of course, rubber bands.(2)

History

Early European explorers learned that Central and South American Indians made "waterproof shoes" by dipping their feet in latex collected from rubber trees and allowing the latex to dry. They also used latex to waterproof baskets. They called the rubber trees "cahuchu" which means "weeping wood." Explorers returned to Europe with samples of this hardened latex. It was discovered that the material could be used as an eraser to rub out pencil marks, hence the name "rubber."

Around 1800, a true rubber industry began with the manufacturing of waterproof products such as raincoats. But early products were sticky in hot weather and brittle in cold. In 1839 Charles Goodyear, an inventor, accidently discovered a way to make rubber stronger and more resistant to changes in weather when he spilled a sulfur-rubber mixture on a hot stove. The rubber was cured by the heat and stayed firm and tough. This process of heating sulfur-rubber mixtures became known as "vulcanization," after Vulcan, the Roman god of fire and blacksmithing.

At first manufacturers used wild, natural rubber from the Amazon region. But by the late 1800s, rubber was being cultivated and grown on plantations in Central and South America, Africa and the Far East.(2)

World Wars I and II increased demand for rubber products. When the Japanese captured the rubber plantations of the Far East during World War II, a synthetic rubber made entirely from chemicals, was developed in the United States. Today natural rubber accounts for one quarter of the total rubber used in the United States; (4) and most products are made from a combination of natural and synthetic rubbers.(2)

Processing Latex

Latex is found in many different trees and plants. It is not a sap, but is thought to be a protective substance which is secreted when a plant is wounded. About 99 percent of all natural rubber comes from the latex of the *Hevea brasiliensis* tree, known as the rubber tree. This tree is not related to the household rubber plant. Rubber trees grow straight and slender to a height of 60-70 feet. The latex flows through a series of tubes in the tree's cambium layer, directly under the bark.

Plantation workers collect the latex by tapping the tree. They cut a narrow, diagonal groove about halfway around the tree. Latex oozes from the cut and flows down the groove and collects in a small cup. The cups are emptied into a large bucket and transported to the factory for processing. The tree tapping does not harm the tree and each tree produces up to four gallons of latex per year, which yields approximately 18 pounds of crude rubber.(2)

Environmental Concerns

Natural and synthetic rubber are processed in similar ways and present similar disposal problems. Most obvious is the problem of unsightly dumping of automobile tires along river banks, on public lands and in vacant lots. When covered in a landfill, tires and rubber products tend to "float", working their way back up to the surface because they are lighter than the soil they displace. Tire shredders can be used at landfills to reduce this floating problem; however, the use of steel-belted tires complicates this process.(2) When tire piles catch fire, thick, black noxious air pollutants are emitted because synthetic rubber contains petroleum products. These fires are very difficult to extinguish and can burn unchecked for months.

Rain Forests

Near the equator of the Earth in Africa, Asia, and South and Central America is a narrow band (two percent of the Earth's surface) of tropical rain forests.(1) The largest rain forests, fully one third of the world's remaining 50 percent, are in Brazil.(3) The rain forest ecosystem is unique because of the amount of rain fall (15 to 30 feet of water per year) and the variety of trees, plants and animals. *Over half the plant and animal species on Earth live in the rain forests!*(5) Many of the unique plants in the rain forest provide medicines, timber, food and rubber.(1)

Rain forests also have an important role in the health of the Earth's biosphere. They affect the weather of the entire planet and the air we breathe. Rain forests play a key role in absorbing harmful carbon dioxide and supplying the Earth with oxygen. (1)

Each year at least 50 million acres of rain forest, an area the size of Nevada, disappears forever. The current rate of destruction is over 150 acres per minute. At this rate the forests will be gone before the year 2050.(5) Rain forests do not simply grow back. Rain forest ecosystems have been evolving for 70 to 100 million years. The ice ages which destroyed most life in the northern hemisphere did not affect the tropics. Consequently, many species evolved that exist nowhere else. When large areas are deforested, many species become extinct.

Soils in the rain forest are very thin and fragile. When exposed to the sun and rain they erode quickly. When grazed by cattle, the soil becomes compacted and sterile. Without the trees, rainfall patterns change and sometimes deserts are created where formerly the richest communities of life on the planet lived.(5)

Rubber Plantations

Although rubber plantations displace some rain forest areas, conversion of the rain forest to plantations is a very small part of the overall deforestation problem. Rubber plantations protect the soil and watershed although they do not have the desirable biodiversity of the rain forest.(3)

Extractive Reserves

Much of the rubber is harvested on extractive reserves, which are large tracts of land set aside for harvesting rubber, Brazil nuts and other products. Generally the rubber industry provides the indigenous people with a good, sustainable livelihood that is a preferred alternative to logging, or slashing and burning the rain forests.

Established in 1985, these reserves remain the property of the Brazilian government, but are managed by and benefit the local communities. While over 7.5 million acres of Amazon Rain Forest are now "officially" protected in extractive reserves, there is no enforced protection and no government subsidies. Therefore, much of this land is under constant threat by cattle ranchers and displaced settlers from other regions.

The establishment of the Brazilian extractive reserves has lead to violence between rubber tappers and wealthy cattle ranchers who prefer to see the forest converted to pasture. A prominent spokesman for extractive reserves, Chico Mendes, was shot and killed by the son of a cattle rancher in 1988.(3)

Forest Conservation and Economic Development

Extractive reserves can link economics with preservation. However, new products, other than rubber, must be identified and marketed. The potential for extracting commercially valuable fruits, spices, sweeteners, pigments, oils, fragrances and (perhaps most importantly) medicines, from tropical forests is enormous.

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9. Filmstrip and Teacher's Guide: The Vanishing Forest: The Crisis of Tropical Deforestation. Grades 4-adult. Filmstrip, cassette and illustrated guide. Available from: Knowledge Unlimited, Inc., P.O. Box 52, Madison, WI 53701. Phone: (800) 356-2303 or (608) 836-6660.

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COPYCAT PAGE

JUNGLE IN THE PANTRY

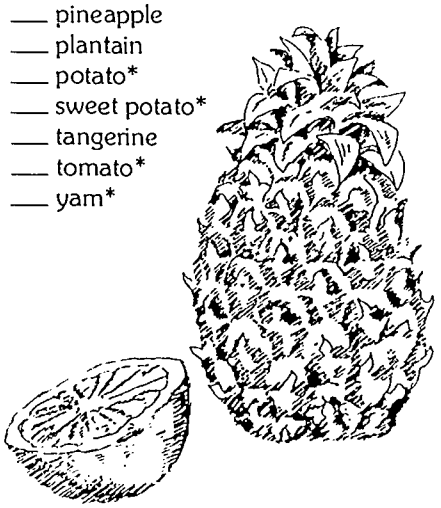
WOODS, CANES, AND FIBERS

Woods
(furniture, floors, doors, paneling, cabinets, carvings, toys, models)
___ balsa
___ mahogany
___ rosewood
___ sandalwood
___ teak*

Canes and Fibers
___ bamboo (cane furniture, crafts)
___ jute* (rope, twine, burlap)
___ kapok (insulation, stuffing)
___ ramie* (knit materials)
___ rattan (furniture, wicker, cane chair seats)

FOOD PRODUCTS

Fruits and Vegetables
___ avocado
___ banana
___ grapefruit
___ guava
___ heart of palm
___ lemon
___ lime
___ mango
___ orange
___ papaya
___ passion fruit
___ pepper
___ pineapple
___ plantain
___ potato*
___ sweet potato*
___ tangerine
___ tomato*
___ yam*



Spices and Flavors
___ allspice
___ black pepper
___ cardamom
___ cayenne (red pepper)
___ chili pepper
___ chocolate or cocoa
___ cinnamon
___ cloves
___ ginger
___ mace
___ nutmeg
___ paprika
___ turmeric
___ vanilla

Other Food Products
___ Brazil nuts
___ cashew nuts
___ coconut
___ coffee
___ corn*
___ macadamia nuts
___ peanuts*
___ rice*
___ sesame seeds*
___ sugar*
___ tapioca
___ tea

HOUSEHOLD PRODUCTS

Houseplants
___ African violet
___ aluminum plant
___ *Begonia*
___ bird's-nest fern
___ bromeliads
___ Christmas cactus
___ *Croton*
___ *Dracaena*
___ dumb cane (*Dieffenbachia*)
___ fiddle-leaf fig
___ kentia palm
___ orchids
___ *Philodendron*
___ prayer plant
___ rubber plant
___ snake plant (*Sansevieria*)
___ spathe lily
___ swiss-cheese plant
___ umbrella tree (*Schefflera*)
___ zebra plant (*Aphelandra*)

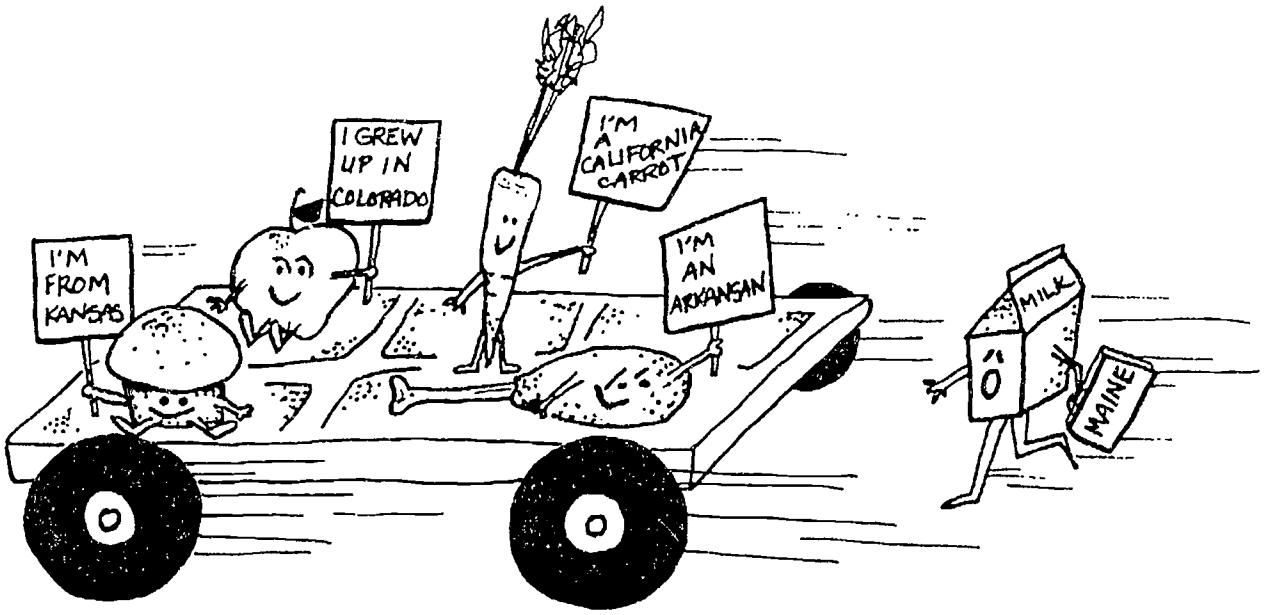
Oils
___ bay (bay rum lotion)
___ camphor (insect repellent, medicine)
___ coconut (snack food, baked goods, lotions, soap)
___ lime (food flavoring, candles, soap, bath oil)
___ palm (snack food, baked goods)
___ patchouli (perfume, soap)
___ rosewood (perfume)
___ sandalwood (soap, candles, perfume)

Gums and Resins
___ chicle (chewing gum)
___ copal (varnish, printing ink)
___ dammar (varnish, lacquer)
___ rubber (balloons, erasers, foam rubber, balls, rubber bands, rubber cement, gloves, hoses, shoes, tires)

* products that may have originated in other types of tropical habitats near rain forests

"A LONG WAY TO LUNCH"

A Lunch Time Story



The Life Cycle of The School Lunch

CONNECTIONS Life Cycle Kinesthetic Learning

"A LONG WAY TO LUNCH"

A Lunch Time Story

SUBJECTS: Social Studies, Science, Language Arts

GRADES: 1-4

ACADEMIC SKILLS: Application, comparing similarities and differences, evaluation, listening, listing, reading, recall, research, speaking, synthesis, visualization, writing

TIME: 10 minute preparatory period before lunch for discussion and brainstorming, 30-45 minute activity and discussion after lunch

MATERIALS: Visualization Exercise (included)

VOCABULARY: Transportation, food processing, life cycle, habitat, depletion, contamination

CONCEPT: Each day we make choices regarding the food we eat. These choices have an impact not only on our health, but on the health of the environment.

OBJECTIVE: Students will be able to recognize that all the food items have a long history and a future. Using a guided-imagery technique, they will begin to understand some of the effort, time, transportation and environmental consequences involved in food consumption.

BACKGROUND: (See attached.)

ACTIVITIES:

Brainstorming Before Lunch

Before lunch, assist the students in making a list on the chalkboard of items which will be used in their lunch, either today, or on other days. Guide them through by questioning if necessary. Try to be sure that all areas of a lunch are represented (vegetables, fruits, breads, meat, milk, trays and utensils) in order to enhance the discussion after lunch. As they leave for lunch ask them to think about where everything they listed on the board came from.

Guided Visualization Exercise After Lunch

Technique Discussion

This activity is intended to encourage and allow students to experience and appreciate the path which food items in their lunch travel prior to reaching them. As the teacher, you will read or describe in your own words a series of images for your students.

You will ask the students to close their eyes to reduce distraction as they form pictures in their mind. It is important to allow a long pause (1 to 3 seconds) between phrasing to allow students sufficient time to create adequate images relative to your suggestions.

Student Preparation

Provide the students with the following instructions prior to beginning this activity:

"In this activity you will be trying to imagine things as I describe them. I will be leaving out some of the details. It will be up to you to try to see and feel the things which I describe.

Let's take some time now to decide who or what you will be in this activity. You may choose to be yourself or any food item you might find in the cafeteria at lunch time.

You do not have to do anything special for this activity. You will feel and experience yourself as the "thing" you have chosen. For a few minutes you will become and follow the movement of what you decide to be. Any questions?"

"Everyone should be in a comfortable position. Be sure you have enough space to be comfortable. If you want to, take a moment to stretch your arms above your head. Ready? Everyone will close their eyes for this activity. O.K. Let's all take a few deep breaths. Ready? In..... Out..... Once again let's breath in.....out..... One more time, in.....Out..... Good!

"PUT YOURSELF IN YOUR LUNCH TRAY"

Now try to picture in your mind all the things which I describe. With your eyes closed, listen and imagine what you hear is real.....It is lunch time.....There are many smells in the air.....some familiar.....some you do not recognize.

There are many sounds.....sounds of mealtime.....conversations.....the sounds of silverware.....the scrape of a knife, the dropping of a spoon.....there are pots clanking in the kitchen.....You hear the sound of someone biting into something crisp... swallowing....children and teachers talking.

You are part of the lunch time meal.....Were you in a box or a can or a bottle before you got to the table?..... Where is your packaging now?.....What will become of it?..... Were you cooked? .....Remember all the faces of the people who were involved in your preparation.

You remember the many places you have been prior to today's lunch..... Perhaps you recall hanging from the tree in the orchard or swaying with the wind in the field where you grew..... or grazing in the rancher's pasture, or pecking in the barnyard, where you were raised for food.

You may recall being picked after growing from a tiny seed to a full grown plant..... Were you sprayed with chemicals while you were growing?

You recall all the people and machines which touched you ..... You remember all of the machines you have encountered..... machines which may have sorted you by size, cooked or froze you, or mixed you with other things.....You remember machines which put you in containers so you would be safe for shipping.

You remember being carried onto the truck.....You recall the sounds of the highway as you rode inside the back of the truck when you were delivered to the school..... Was it cold inside the back of the truck?.....You think of all of the places you have been.....You may recall the truck driver stopping for gasoline and to get some lunch..... You may recall the smell of the exhaust fumes from the truck.

You continue to hear the sounds of the cafeteria.....students slurping through straws..... a spoon dropping on the floor..... someone scraping her plate.....the sounds are changing now..... .....growing louder, as more students arrive.....growing softer .....as students go outside to play.....Finally, you realize that lunch time is coming to an end..... Were you eaten?.....Perhaps you were scraped into the garbage...or taken into the kitchen to be thrown away.....or saved for another day. The bell rings.....and then... .lunch is over.

Wait a few seconds and then tell the students, *"Open your eyes."*

Post Activity Discussion

1. It is time to find out what the students experienced during this activity. Allow students to volunteer to share their experiences. They should include who or what they were--that is, plant, animal, themselves, etc.

2. Have students compare experiences for different lunch items. Are tnere other items which were in the lunchroom or a part of the lunch experience that they did not list in their brainstorming session before the activity?

3. Discuss the life cycle of other components of today's meal including utensils used, plastic trays, packaging, etc. Have students read labels and any manufacturers stamps which may be on the utensils, trays, etc.

EXTENSIONS:

1. Draw pictures of what you imagined.

2. Play a game of charades. Ask the students to act out their lunch item while other students guess what it is.

3. Write a story telling the life story of a lunch item.

4. Taste test - Have students examine food products in the fresh, frozen and canned state. Ask them to record their observations. Things to observe are color, texture, smell, etc. Then have students predict which will have the best taste based on their observations.

   Consider the impact on the environment of each type of food processing. Which product takes the least amount of processing? Which one creates the most waste products? (Fresh vegetable or fruit waste can be composted whereas frozen product waste includes either a bag or box. Canned products leave a can and the accompanying label as waste residual.)

5. If the students did not know the life cycle of some of the components of their lunch, have them bring to class some examples of those items. Have the students observe the item, research the item, and list the steps of the product's life cycle including what happens to it after lunch. Students could then diagram and present their findings and/or ideas to the class.

6. Have a small group of students take a tape recorder or a video recorder into the lunchroom for several lunch periods. Have them "zoom in" on all the sounds and processes going on there. (Kitchen noises and processes, lunch service noises, kids eating and taking their trays to the clean up area, quiet cleaning after all the students are gone.)

7. Older students could prepare an investigative report for radio or television. They could "interview" a food item, discussing where it has been and what it has experienced. They could also interview students in the lunch room to find out where they think their food comes from and what their understanding is of food growing and processing.

BACKGROUND INFORMATION:

Guided Imagery in the Learning Process

In this activity students participate in an instructional technique known as guided imagery, in order to experience the life cycle of the items in their lunch. This research-supported technique enhances long-term memory and comprehension while providing avenues for processing information.

Guided imagery is in widespread use throughout professional athletics and the performing arts. Famous golfer, Jack Nicklaus, credits 50 percent of his success to mental rehearsal of the correct form for the shot.(1) Imagery of this type has been shown to result in subliminal muscle activity associated with the imagined actions.(2)

Guided imagery is a valuable tool for students and teachers alike and provides reinforcement to many other instructional techniques.

Food Production

In discussing environmental issues, the manufacturing and processing of food is often neglected. The places and manner in which food is produced will have an effect on the environment. One environmental impact of food production is loss of habitat due to agricultural usage, or the development of industrial or commercial food processing entities.

Common growing practices include the use of herbicides, pesticides, fungicides and insecticides which can pollute water supplies, affect food sources for wildlife and result in top soil depletion. Some of these toxic substances have been shown to accumulate in the bodies of animals as well as people.

The Changing Food Industry

Food production has greatly changed over the years. Nearly 80 percent of the people living in this country were farmers at the turn of the century. Currently 2 percent of our citizens are farmers.(3) With the human population growing by the equivalent of 11 Somalias or 12 New York Cities a year, the world's food producing capacity has been seriously strained.(4)

Quality and Quantity

Historically, farming practices were based on long standing methods which emphasized maintaining the fertility of the soil. Currently most of our food supply is made up of plants that are actually malnourished because they are fed limited nutrients from artificial fertilizers. Because of consumer demand stimulated by influential advertising, these plants are bred for yield and uniformity rather than for taste or nutrition.(3)

Processing and Packaging

Once produced, these foodstuffs are processed at a factory. Processing extends the life of a food, however the loss of nutritional value is high. Peas, for example, lose 30 percent of their nutrients during canning and lose another 25 percent in the sterilization process. An additional 27 percent of the nutrients are discarded with the cooking liquid; and 12 percent are lost in reheating once the can is opened. At this point the peas are left with only 6 percent of their original nutritional value. Frozen peas are left with approximately 17 percent of their nutrients after processing and cooking.(3)

Packaging and marketing further impact the environment during the life cycle of our food. Transportation of food results in air pollution and depletion of limited oil reserves. In addition, the average food product has traveled 1400 miles prior to reaching our tables.(3)

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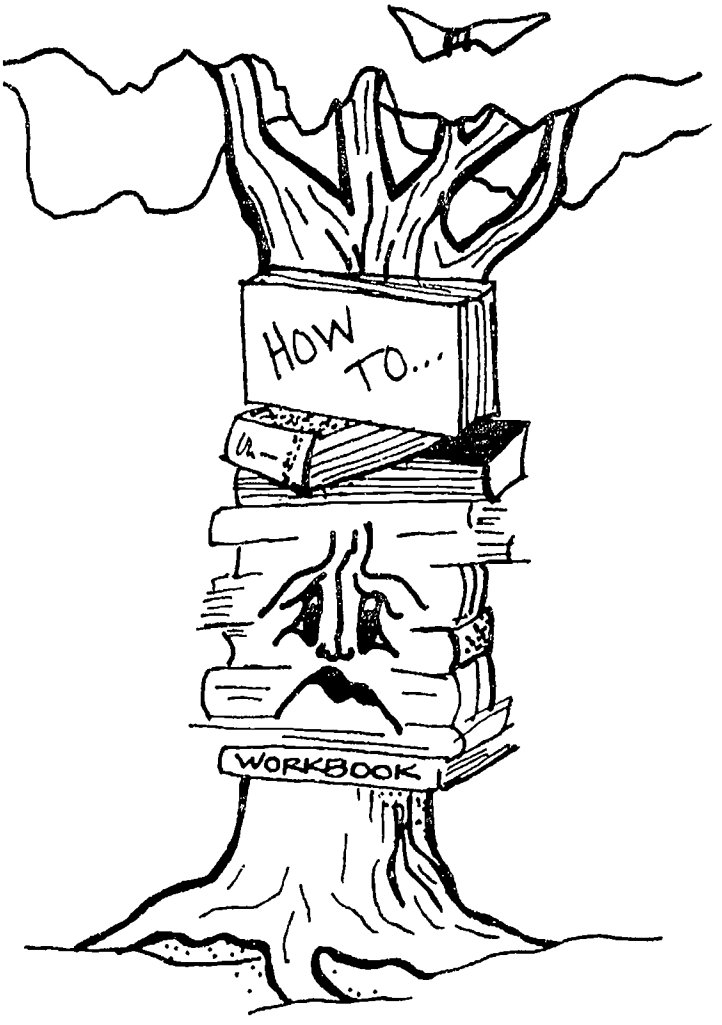
"CHIPPING AWAY AT THE FOREST"



The Life Cycle of Paper

"CHIPPING AWAY AT THE FORESTS"

SUBJECTS: Art, Drama, Language Arts, Science

GRADES: 2-5

ACADEMIC SKILLS: Classification, discussion, listing, memorizing, public speaking, synthesis

TIME: Two 30-45 minute class periods

MATERIALS: Puppet making materials, puppet theater materials, copies of the play to cut up to give students

VOCABULARY: Fibers, pulp, mills, official, logger, pollution, exhaust, plantation

CONCEPT: Although approximately two-thirds of the pulp used in paper comes from lands owned by the forest industry, a great percentage still comes from our National Forests. As the old growth forests are cut down, valuable habitat for many species is seriously damaged or lost. Since world demand for paper is expected to double early in the next century, there will be increasing pressure to cut down the remaining virgin (uncut) forests unless manufacturers begin to make paper from other fibers. As consumers of paper, we are responsible for conserving paper, and recycling it whenever feasible.

OBJECTIVE: The students will be able to demonstrate their understanding of the life cycle of paper. The students also will be able to explain the need for conserving and recycling paper products.

BACKGROUND: (See attached.)

ACTIVITIES:

Brainstorming Session

Ask the children to help you make a list of creatures they would expect to find in forests, forest ponds or streams. Have them think of different kinds of creatures that fly, run or climb with four legs, swim, hop, crawl, buzz, or slither. Ask them to also think about other kinds of plants that live in a forest in addition to trees. Write the entire list on the board or overhead.

Puppet Making

Each child will make their own puppet to be used in the following puppet show. There are five main characters: Wood Chip, Oliver Owl, The Logger, The Truck Driver, The Papermaker.

Choose five students to play these characters and ask them to make an appropriate puppet. The remainder of the cast plays an assortment of forest creatures. Ask all the other students to choose a forest creature from the list on the chalkboard and make and name an appropriate puppet.

The play includes 23 speaking parts not including narration (which may be done by the teacher for the lower grades), a special effects person and two crowd scenes. This should allow each student to participate in both the puppet making and the puppet show.

Provide the students with as many materials as possible. The base of the puppets can either be old socks or small paper bags. (Younger students may find it easier to decorate the paper bags.) Collect, or have the students collect, items from outdoors. These could include feathers, acorns, twigs, flowers, small stones, or even trash. Cloth scraps, buttons, yarn, ribbons, used paper, cardboard and pipe cleaners will also work well. Students will need tape, glue, staples, or other methods of fastening objects to their base. Allow the students complete artistic freedom.

Students will also need to create the "scroll" and the three signs needed for props, as described in the play. Students can also assist in making the puppet theater, if needed.

When the puppet show is ready, stage it for the school, parents, or other classes.

Puppet Show Script

THE ADVENTURES OF WOOD CHIP
"The OFFICIAL Forest Reporter"

NARRATOR It was the third day in a row that Wood Chip the OFFICIAL Forest Reporter was awakened to the sounds of buzzing saws. The noise was very loud, but louder still was the sound of trees falling. They crashed like great thunder and the whole forest shook.

It was very different from the quiet and cozy life Wood Chip was used to. He and all the forest creatures were confused and frightened by the loud activity.

Oliver Owl, a smart old bird, called an emergency meeting in the meadow for the afternoon.

SCENE I

OLIVER OWL We are gathered together to talk about what is happening to our forest home. Whooooooooo would like to start?

1ST CREATURE My family and I have lived long and peacefully in the Old Pine Tree. Now that tree is gone. (sobs briefly) It was chopped down yesterday! We have to move away and we do not understand why. Who can tell us?

OLIVER OWL Yes, Whoooooo?

2ND CREATURE This morning the saw dust from the tree cutters was so deep it covered ALL the ferns and made them sick. It even buried all the ant hills. The ants too have had to move away. WHO is doing this and WHY?

OLIVER OWL Yes, Whooooooooo?

3RD CREATURE I have seen that it is people who are doing this. They use their saws and sometimes they even sing HAPPY songs while they are cutting down OUR trees. Who will talk to them and ask then WHY they are doing this?

CROWD SCENE WITH ALL THE FOREST CREATURES Who? Yes Whooo? Who?

WOOD CHIP (clearing his throat loudly and moving to the front of the group.) I think it should be me! After all I am Wood Chip, the OFFICIAL forest reporter. I will go and talk to them right now!

CROWD SCENE WITH ALL THE FOREST CREATURES Hooray! Fantastic! Terrific!

SCENE II

NARRATOR Wood Chip went back to the forest and waited for the saws to stop buzzing. Then with GREAT courage he called to one of the loggers.

WOOD CHIP Excuse me sir, I am Wood Chip the OFFICIAL forest reporter. I have been sent to talk to you. Why are you cutting down our trees?

LOGGER I am _____ (let the puppet maker decide the loggers name). I am cutting down these trees because it is my job. I have to work to feed my family.

WOOD CHIP What do you do with our trees after you have cut them down?

LOGGER I take them to the truck driver over there in that big orange truck. She loads them and takes them to many different places. I do not know where she is going today, but you can ask her.

WOOD CHIP Thank you woodcutter, I believe I will.

SCENE III

NARRATOR Wood Chip looked again at the big truck and remembered that it could move very fast. He was a little frightened, but he decided to go and talk to the driver anyway. When he arrived, she was just finishing her lunch.

WOOD CHIP Excuse me. I am Wood Chip the OFFICIAL forest reporter. Can I talk to you about our trees?

TRUCK DRIVER (wiping crumbs from her mouth and making a big "GULP" noise) I am just leaving to make a delivery. I would be glad to talk to you if you could ride along.

WOOD CHIP Well okay, but will you bring me back when we are through?

TRUCK DRIVER Sure, but hop in! I'm running late, so we have to hurry!.

SPECIAL EFFECTS PERSON (Hit powdered rags or chalk board erasers together to make "exhaust" fill the air. NOTE: IF ANYONE HAS ALLERGIES OR ASTHMA, use alternate means, such as spraying a water mist in the air. Make truck sounds and coughing sounds.)

WOOD CHIP What IS this dirty smoke? It makes my eyes burn!

TRUCK DRIVER The smoke is called exhaust. It comes from burning gasoline which makes the truck run.

WOOD CHIP (coughing) Where are we going with this truck full of trees?

TRUCK DRIVER We are going to the paper mill so these trees can be used to make paper.

WOOD CHIP I am even MORE confused now. How can anyone turn TREES into PAPER?

TRUCK DRIVER I don't know; but I'm sure you can talk to the Papermaker. Here we are now.

WOOD CHIP Thanks for the ride. I'll see you later.

SPECIAL EFFECTS PERSON (HONK! HONK! Hit powdered rags, or spray mist in the air again)

TRUCK DRIVER Good-bye Wood Chip. Good luck!

SCENE IV

WOOD CHIP (sniffling) Excuse me Papermaker. I am Wood Chip the OFFICIAL forest reporter. Can I ask you some questions?

PAPERMAKER Yes, you may Wood Chip, but why are you crying?

WOOD CHIP I am NOT crying! Some of that exhaust smoke got in my eyes and made them tear up (looking up). Is that the same stuff coming out of your chimneys?

PAPERMAKER Yes. Big trucks and paper mills can sometimes cause a lot of air pollution. What are your questions?

WOOD CHIP Will you tell me how you turn trees into paper? It sounds like MAGIC and I LOVE magic.

PAPERMAKER Well, it is not magic at all. It is a lot of work! First a machine cuts the trees into small little chips. Then another machine mixes the chips with water. All the little fibers from the wood make a pulp. Big rollers squeeze the pulp together and get the water out. Then it goes through special machines which dry it. When it is done, it is PAPER!

WOOD CHIP Wow! That IS a lot of work and A LOT of machines. Now I understand how you turn our trees into paper. But, I don't understand why. What DO you use paper for?

PAPERMAKER (pulling out a scroll on which the children have listed uses of paper....the scroll rolls out into the audience.) Let's see, we have art work, bags, books, calendars, cards, cups, desk-top pads, envelopes....

WOOD CHIP (interrupting) Whoa! I've heard enough. Paper IS very important to you. I can see that. Now I understand why the trees are being cut down from my forest. But now I am truly sad. (sniffling)

PAPERMAKER Why are you so sad little Wood Chip?

WOOD CHIP (sniffling still) Because if you keep using so much paper, ALL the trees in my forest will be cut down. My friends will have no place to live or play. And it will get very hot without the shade from our big green trees.

PAPERMAKER Oh, dear little Wood Chip, you are only partly right. It IS true that some companies cut down entire forests. But others don't. Other companies cut only some of the trees and they even plant new ones. And other companies don't even go to the forest!

WOOD CHIP Then how do they get the trees to make paper?

PAPERMAKER They grow special tree gardens called plantations. And some very smart people are even dreaming up ways to make paper out of other plants besides trees! But for now, there is one more thing you should know about. It's a way EVERYONE can use fewer trees and STILL have paper. It's called RECYCLING.

WOOD CHIP Recycling?

PAPERMAKER Yes. When people use old paper to make new paper it's called recycling.

WOOD CHIP I LIKE recycling!

PAPERMAKER Me too!

WOOD CHIP Well, Papermaker, I now have all my questions answered. I must get back to the forest and talk to my friends.

NARRATOR Wood Chip travelled back to the forest. When he arrived, the first thing he noticed was the quiet. There were no buzzing saws. The second thing he noticed were the small trees that had been planted. He jumped with JOY! But he knew that he and all his other forest friends would have to take care of the baby trees, because there were no longer any big trees around them to shelter them during the winter. He also knew it would be a very long time before the trees were big enough to be anybody's home.

WOOD CHIP Hey everybody, I'm Home!

CROWD SCENE (All the forest creatures gather together and welcome Wood Chip back.)

4TH CREATURE Welcome Home Wood Chip, I'm happy you're back!

5TH CREATURE It's good to see you! I can't wait to hear about your truck ride.

6TH CREATURE Hi Wood Chip! What did you learn from the people?

OLIVER OWL Shhhhhhhhh! I have an announcement to make! Since Wood Chip has returned, there will be a meeting tonight in the clearing near the blueberry bushes. Wood Chip can report to us what he learned. Whooooooo will be at the meeting?

CROWD SCENE WITH ALL THE FOREST CREATURES We will! We will!

PARADE SCENE I

NARRATOR The forest creatures gathered and had a VERY long meeting. Wood Chip shared all that he had learned. Now the forest creatures would like to share it with you!

7TH CREATURE (carrying a sign that says "SAVE OUR FORESTS, DON'T WASTE PAPER!) We can all help save our big beautiful trees.

8TH CREATURE The best way to do this is to USE LESS PAPER. We can use the backs AND the fronts of paper before we throw it away. We can use a piece of paper ALL UP!

9TH CREATURE When we use less paper, fewer trees get cut down.

10TH CREATURE And then less energy is used to run the saws, the trucks and the paper making machines.

7TH, 8TH, 9TH, & 10TH CREATURES (in unison) SO USE LESS PAPER!

PARADE SCENE II

11TH CREATURE (carrying a sign that says SAVE OUR FORESTS, REUSE PAPER!) Another way to save trees, energy AND water is to reuse paper as many times as we can.

12TH CREATURE Instead of throwing our folders away each year, we can decorate them and use them over again.

13TH CREATURE When we reuse our paper, less pollution is created by logging trucks and papermills.

14TH CREATURE And that means it will be easier to breathe and our eyes will feel better.

11TH, 12TH, 13TH, & 14TH CREATURES (in unison) SO REUSE PAPER!!!

PARADE SCENE III

15TH CREATURE (carrying a sign that says "SAVE OUR FORESTS, RECYCLE!) Recycling is very important too!

16TH CREATURE Every time we recycle a four foot stack of paper, we can save one whole tree.

17TH CREATURE And paper that is recycled does not become trash.

18TH CREATURE It would be better for all of us to have less trash.

15TH, 16TH, 17TH, & 18TH CREATURES SO ALWAYS RECYCLE YOUR PAPER!

FINAL SCENE

OLIVER OWL Remember, every one of YOOOUUUUUU can make a difference! Thanks for helping to save our BEAUTIFUL forests.

THE END

Variation

Divide the class into two teams, reduce the number of characters, and have each team perform the puppet show for different classes.

EXTENSIONS:

1. **Drama and Art Activity** - "Connections Game" (30 minutes) Grades 1-2.

   Make a list of things associated with the life cycle of paper (clouds, rain, soil, trees, squirrel, bird, logger, logger's child, truck, gas, exhaust, paper mill, machines, electricity, store, store worker, student, Big Chief Tablet, trash can, dump, recycle center, etc.) Have each student choose one of these items and draw a small picture of it, with a caption written under it for others to read. Then have them tape it to bands of paper to make a headband.

   When the students have their headbands ready, tell them they are going to play the "Connections" game. This game will require a large open space. Each student will assume the identity of the person or object they have drawn. Ask the students to stand in a circle. Then give a ball of string to one student and ask him/her to hold onto the string and pass it to another student with whom his/her role is connected. Have that person announce to the class why he/she feels connected to the student chosen. Once every student has the string, continue passing it to different connections. Do this until the children realize that all the roles are connected.

2. **Art Activity** - Life cycle Posters (30 minutes) Grades 2-5.

   After discussion of the life cycle of paper including recycling, have the class work individually or in small groups to design posters to help educate the school about the importance of paper and the importance of reduction, reuse and recycling.

3. **Drama Activity** - Videotape the puppet show, or write a short play and videotape it. (Three 30-45 minute class periods) Grades 4-5.

   Discuss in detail the processing of paper, its effects on the environment and the possible solutions to the problems caused by logging, transportation and the irresponsible disposal of paper. Have the students write short commercial-like scripts. Using the writing process, refine these scripts. Rehearsal should only take one class period. Videotape the final products for evaluation and share with other classes.

4. **Language Activity** - Persuasive Speaking (Two or three 30-45 minute class periods) Grades 4-5.

   Discuss the environmental issues of paper usage. Introduce persuasion and methods of persuading. Give examples of persuasive speeches and their purpose. Have the students choose a topic concerning paper making and write a persuasive speech. Use the writing process to achieve a final product. Present the speeches to your class

and/or to other classrooms. Have the students write to the manufacturers of various paper products encouraging the use of alternative fiber sources. (See Background for a list of alternate fibers.)

5. **Service Learning** - School Wide Recycling Project (Two or three 30 minute class periods with ongoing follow-up) Grades 4-5.

Design and set up a recycling center within your school. Use any of the activities above to educate the entire school about the importance of everyone recycling. You can choose to transport the paper to the recycling center, or use the paper to make small note pads to sell as a fund raiser. Keep a record of the number of trees saved. For evaluation purposes, discuss with the students how it feels to do a service project and what it means to them.

6. **Art Activity** - Torn Paper Art (30 minutes) Grades 2-3.

To help the students understand the fibrous make up of paper, tear a scrap of paper and hold one of the torn edges up to the light. Along that edge will appear a slight fuzz. Here and there tiny strands will project separately, like fine hairs. These strands are cellulose fibers.

Discuss with the children all the different materials from which fibers can be harvested to make paper. (See Background.) Show them fibers from a small piece of cloth to illustrate the point.

Using scraps of construction paper, tear and glue different colors to represent the forest and creatures who depend on the forest for survival. Display these pictures throughout the school to heighten awareness of the need to conserve and protect natural resources.

7. **Guest Speakers** - (usually an hour) All grades.

Ask an employee from the Forest Service, or the Bureau of Land Management to talk to the class about forest creatures. If a paper company is located in your area, ask them to present their company's view of logging in national forests. Ask a person from a local recycling center to address the recycling process and to assist in setting up the school recycling program. Since paper usage is quite different than it was during the early part of the century, ask an elderly person to speak about their recollections of paper use when they were a child.

8. **Mime Activity** - (30 Minutes) Any grade.

Have children create a mime presentation to represent how paper "feels" going through various stages, even being squashed, tossed into a waste basket and added to a landfill, or being reused or recycled.

9. **Reading** - (45 minutes) Grades 1-4.

Read and discuss The Lorax by Dr. Seuss, or The Great Kapok Tree by Lynne Cherry.

BACKGROUND INFORMATION:

In America's trash, paper is "king of the mountain". In 1990 73.3 million tons of paper were discarded, making paper the single largest component of the municipal solid waste (MSW) stream. By weight, paper is nearly 40 percent of everything we throw away.(1)

While it seems that recycling should have decreased our paper waste, it has not. As of 1990, the paper recycling rate in the U.S. was 35 percent, lower than it had been during World War II when 43 percent of paper was recycled.(2) Increased recycling is a partial solution to the nation's solid waste problem as well as alleviating a number of other environmental consequences associated with paper consumption. (See attached "Benefits of Recycling Paper".)

However, the reduction of paper use, development of alternative pulp sources and the purchasing of recycled paper and recycled paper products are also necessary if we are to reduce the environmental impacts of paper use.

A Brief History of Paper

The first known inventor of paper was a Chinese court official, Ts 'Ai Lun, who lived in the first century A.D.. To make paper, he used the bark of mulberry trees, scraps of silk cloth, hemp, china grass and worn out fishnets. This process for making paper was kept secret until Muslims went to war with China and two papermakers were taken prisoners. The process then spread throughout Europe.(3)

In 1666, the English Parliament passed a law forbidding the use of cotton or linen for burying the dead in order to save the material for paper mills.(5)

In 1719, a French naturalist and physicist, Rene Antoine Ferchault de Reaumur, began to study the wasp. He discovered that wasps were nature's papermakers. The wasp chews wood and plant fibers into a powder which it mixes with an adhesive produced in its own body. This results in a fine pulp, which the insect eventually transforms into many layers of paper. The paper is exceptionally light weight, dark gray in color and quite tough. It is also water resistant.(4)

These observations of wasps lead Reaumur to convince his government that cloth fibers were not the only fibers that could be used to make paper. Even with this incredible information, it took about a century before the process was changed from the use of rags to wood.(4)

In 1828 the first mill to make paper from straw was built in Pennsylvania; and not until 1840 was the first process developed for making paper from wood pulp.(5)

Our Disappearing Forests

Four hundred years ago, over one billion acres of virgin (never cut) forest covered what is now the United States. Today, less than five percent of this once-vast woodland remains. The remaining virgin forest is being cut at the rate of over one million acres a year. Although destruction of tropical rain forests has been more widely publicized, the public forests in the United States are in far worse condition than the tropical forests in Brazil.(7)

The logging and paper industry plants millions of trees every year to replace trees it has cut. Many of the seedlings fail to survive, particularly in clear-cut forest areas that are prone to erosion. Large scale clearcutting turns forests, with all of their biodiversity, into a monoculture of same-aged trees growing in nutrient depleted soils.(7)

Many species suffer when old-growth forests disappear. Some are driven to the edge of extinction. Biologists call some species "indicator" species, which means an entire eco-system is in danger when these creatures are endangered. The northern spotted owl in the Pacific Northwest is an indicator species for at least 160 other kinds of birds and animals.(7)

Although logging the last of America's virgin forests on public lands provides jobs and low cost timber for the logging and paper industries, a 1989 Forest Service report showed that the National Forests are actually worth much more if left intact than if they are logged.(7)

The 1989 Resource Planning Act Assessment Report by the U.S. Forest Service said that commercial salmon fishing, recreation, tourism and hunting in America's national forest generate nine times more income annually than logging - $122 billion compared to $13 billion.(8) Gross receipts from timber sales amounted to less than $2 billion.(7)

Timber sales result in a net loss to the taxpayers after the Forest Service builds and maintains roads into areas to be logged. A report for the House of Representatives Government Operations Subcommittee on the Environment showed that the U.S. Forest Service has lost at least 5.6 BILLION tax dollars from its timber program over the last ten years through below-cost timber sales.(7)

More than half the cubic volume of trees harvested in our national forests is used to manufacture pulp and paper. The Tongass National Forest in Alaska, containing 17 million acres of uncut old growth, is being logged to provide pulp for paper in Japan.(7)

Making Paper Without Trees

The world's paper demand is expected to double by the year 2010. The result may be more pressure on the existing natural forests, unless paper manufacturers find other means to produce their raw materials.(9)

Good paper is made from non-wood sources around the world: from rice and barley straw in China, from sugar cane waste (bagasse) in Mexico and India, from bamboo in Vietnam and from the kenaf plant in Australia.(9)

Kenaf is a fast-growing plant that produces two to four times more pulp per acre than the southern pine tree. Kenaf pulp meets all of the technical requirements for most grades of paper and can be harvested annually, whereas trees require 7 to 30 years of growth.(9)

Existing agricultural waste, such as straw left over from rice, wheat, oats, barley and rye generates enough pulp to supply most of the world's paper needs without any use of trees. Fiber crops such as kenaf, bamboo and hemp could require less than half as much land as trees to produce the same amount of paper. These crops are also valuable for adding nitrogen to the soil. For example, India produces 100 million tons of rice straw per year, 15 times the amount needed to meet its own paper needs.(9)

In 1992, treeless paper was made in 45 countries and accounted for 9 percent of the world's total paper supply. But in North America, where the per capita consumption of paper is six times the world average, 99 percent of paper comes from wood.(9)

BENEFITS OF RECYCLING PAPER

1.) Recycling adds to economic stability by creating new material resources (waste paper--"the urban forest"), reducing trash disposal costs and by reducing our use of imported fossil fuels. Harvesting waste paper in cities creates five times as many jobs as harvesting the raw material from trees.(2)

2.) The energy saved from producing a ton of paper from recycled pulp is 64 percent of that used to produce a ton of paper from virgin tree pulp.(2)

3.) 74 percent less air pollution is produced from the manufacturing of recycled paper compared to paper from virgin wood pulp.(2)

4.) 35 percent less water pollution is produced from the manufacturing of recycled paper compared to paper from virgin wood pulp.(2)

5.) Recycled paper uses 58 percent less water compared to virgin paper production.(2) Most paper mills can be found near lakes and rivers. This is because a great deal of water is used in the paper making process. It is estimated that 175 gallons of water is used for every pound of finished paper.(6)

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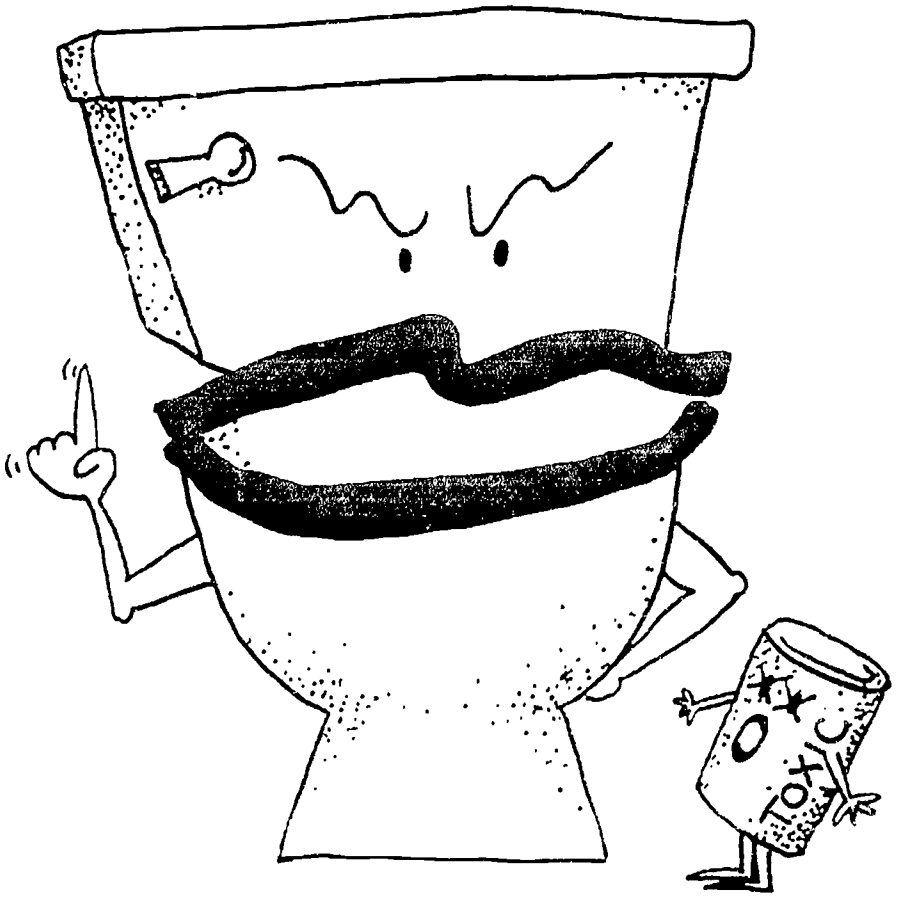
"TO FLUSH OR NOT TO FLUSH – THAT IS THE QUESTION"



The Life Cycle of the Flush

The Life Cycle of the Flush

"TO FLUSH OR NOT TO FLUSH, THAT IS THE QUESTION"

SUBJECTS: Science, Art, Movement Exploration, Music, Math, (in extension activities)

GRADES: 2-4

ACADEMIC SKILLS: Analysis, comparing similarities and differences, discussion, drawing, evaluation, listing, kinesthetic concept development, synthesis, psychomotor

TIME: Two 30-45 minute class periods

MATERIALS: Water drop handouts, yarn, wastewater treatment video, overhead of water cycle (optional)

VOCABULARY: Waste water, toxic, bacteria, precious, decomposition, hazardous, pollution

CONCEPT: WATER IS PRECIOUS! Household water, including water used in the "flush," often unwittingly becomes the point where toxic pollutants enter the water cycle. If we pour hazardous waste down our toilets or drains, it could end up in our drinking water.

OBJECTIVE: Students will be able to explain the importance of keeping toxic items from entering the water cycle through the home or outside storm drains. They will tour or study the operations of a waste water treatment plant and participate in a series of art and movement exercises designed to explore the life cycle of the toxic versus non-toxic flush.

BACKGROUND: (See attached.)

ACTIVITIES:

Discussion

Review nature's water cycle with the class and talk about what constitutes a hazardous or toxic product which should be kept out of the water cycle. If desired, make an overhead out of the enclosed sketch of the water cycle.

The Waste Water Treatment Plant

Choose one or more of the following activities to explain the function of the waste water treatment plant.

1.) Take a tour of a local municipal waste water treatment plant.

2.) Invite an employee of the local waste water treatment plant to explain waste water treatment to the class.

3.) Watch "The Waste Water Video," available from your local sewage treatment plant, or available for a fee from:

The Water Environment Federation
Public Education Department
601 Wythe Street
Alexandria, VA 22314-1994
1-(800)-666-0206

4.) Read "The Magic School Bus at the Waterworks" by Joanna Cole.

Explain the similarities and differences between septic and municipal waste water treatment systems.

Water Drop Necklaces

Give each student a sheet of paper onto which a large water drop has already been drawn on both sides. (See attached.) On one side of the paper, printed inside the water drop are the words, "I'M TOXIC, DON'T FLUSH ME." On the reverse side of the paper, inside the water drop are written the words, "WATER IS PRECIOUS, AS PRECIOUS AS . . ." Instruct students to draw one or several toxic items that should not be flushed down the toilet (e.g., paint, oil, chemicals) inside the water drop on the "toxic" side of the paper. On the other side instruct them to draw pictures of one or more persons or items that are precious to them (e.g., grandma, grandpa, a pet, a bicycle).

Once the drawings are completed, have the students cut out the water drop, then punch a hole near the top of the drop using a paper punch and finally thread a string of yarn through the hole to create a necklace. The necklace has a positive "precious" side and a negative "toxic" side depicted by the students' drawings.

Following the Flush: Movement, Song and Toxic Chant

Invite the children to participate in an interpretive movement, song and chant to follow the path of non-toxic and toxic waste water flushed down the toilet. After the flush the water goes to the water treatment plant before being released to the water source. Children will observe that toxins in the waste water cycle pollute non-toxic water making it difficult to have healthy water to drink and use at home.

Classroom Setup

The goal is to create a mock set-up of the pipes and the waste water treatment plant. To accomplish this, first create a long winding aisle with rows of desks or chairs representing the pipes leading from the home toilet and going to the treatment plant. The pipes can also be created by placing tape on the floor. The treatment plant can be depicted by a large open space outlined by student desks. It is important to leave an "in-flow" and "out-flow" for the treatment plant. A shorter aisle can represent the pipes leading out of the treatment facility where treated water is released into the local water supply.

Music

Teach the students the song "Flush" (sung to the melody of "Row, Row, Row Your Boat") and the "Toxic Flush" chant.

FLUSH

Flush, flush, what a rush/
gently down the pipes/
swirling, twirling, swirling
twirling/everything's all right.

TOXIC FLUSH CHANT

I'm toxic, don't flush me.
I spoil the water every time.
I'm toxic, don't flush me.
I spoil the water every time.

The Movement:

1.) Instruct the students to put on their "necklaces." Divide the students into two equal rows. One row will represent the "toxic flush" and one will represent the "non-toxic flush."

2.) The students in the "non-toxic flush" row turn their necklaces so the "precious" or positive side is showing. The other students have the "toxic" or negative side showing.

3.) Encourage the students in the "non-toxic" row to practice happy, lively movements. (Motivate students to do this by asking them to show you how they would act if they had just received a great gift for their birthday.) Have them utilize their arms to pretend they are swimming. Encourage the students in the "toxic" row to practice slow, heavy, sad movements while pretending to swim. (Motivate students to do this by telling them to move as if everyone had forgotten their birthday.)

4.) Ask the students in their rows to step up to the pipes and pretend to be flushed. (Flipping the hand as if it is a handle and then turning in circles while spiraling downward is one way to do this.) Once everyone has been "flushed," begin the singing and chanting. All the students in the non-toxic row sing the "Flush" song while the others recite the "Toxic" chant. They enter the pipes in pairs and follow each other with their respective happy or sad movements all the way to the waste water treatment plant.

5.) Once the students have entered the treatment plant, the singing and chanting comes to an end. Have the students mix and mingle and tell them the process of water cleaning has begun. Encourage students to pretend that friendly bacteria are munching them. (Hands can be used as mouths and munching and crunching sounds can be encouraged.) At this point, the air bubbles arrive and the students can pretend they are standing inside a bottle of clear soda pop with the air bubbles rising.

6.) Tell the students that the water has now been cleaned to meet government standards. Unfortunately, this means that some pollutants are still in the water. Instruct the children to freeze. Once everyone is still, have them pair up with the student closest to them.

Each pair of students will now examine their necklaces. If either of the students in the pair has the negative or "toxic" picture facing out, the student with the "precious" side must turn his/her necklace over. Tell them they have been polluted by the toxic water. Then both students will be wearing their necklaces with the toxic sides showing. Have all of the pairs with the negative signs showing leave the waste water treatment plant and remind them to move in their slow, sad, heavy swimming movement. Have the remaining pairs with their positive signs showing follow with happy, excited movements.

Once the students reach the river, tell to them separate into two groups again. At this point, have them notice how much more water has been contaminated by the flushing of toxins.

Variations

1. After the students notice the amount of affected water, they can repeatedly go back through the cycle to observe how quickly all the water becomes contaminated.

2. In the beginning, the movement can start with just one toxic flush and then the students can observe how the toxins spread and eventually affect all the fresh water.

Discussion Questions

1. What are some other alternatives to flushing or pouring toxins down the drain? (Using less toxic products, recycling used oil, giving away paints and thinners, taking toxic products to a household hazardous waste facility)

2. Where, besides the drains in the home, are toxins likely to enter the water system?

3. What are some other unneeded flushes in the home? (spiders or other insects, using the toilet as a trash can)

4. Discuss other ways that water is wasted in the home. (running water while brushing teeth, long showers, etc.)

EXTENSIONS:

1. Examine containers of toxic products that are examples of hazardous products in the home which should not enter the water cycle. Label these containers as to their hazardous or toxic properties.

2. Perform the following demonstration which shows the difference between how much water is on the earth and what amount of it is available for human use.(4)

Extension Procedure

1.) Have students bring 10 one-gallon milk containers to the classroom. Fill these jugs with water and tell students that these jugs of water represent all of the water on the earth.

2.) From one container, have students pour 4 cups of water into 4 one-cup containers. Have them pour 1/2 cup of water in a fifth one-cup container. This represents all of the fresh water on earth.

3.) Then put green dye and salt in the rest of the water in all ten gallon containers to represent sea and ocean water that is unavailable for our use.

4.) Instruct students to label the four cups of water "Frozen/Glacial Water."

5.) From the 1/2 cup of available fresh water have a student take an eyedropper and count 8-1/2 drops to represent all the earth's water that is available for daily use and for drinking.

6.) The last 1/2 drop represents the available unpolluted water in lakes, reservoirs, etc.(4)

BACKGROUND MATERIAL:

The earth is about 70 percent water, approximately the same percentage of water as the human body. Of all of the water on earth, 97 percent of it is in the oceans and 3 percent is fresh water. Of the 3 percent fresh water, a little over 2 percent of this is tied up in glaciers in the North and South Poles and other inaccessible areas. This leaves about .632 percent of fresh water (less than 1 percent) available for all daily uses.(1)

One area where clean, treated water is used in great amounts is in the home. About 38 percent of total household water is used for the "flush" alone, and each "flush" uses five to seven gallons of water (2). This is typically the largest single in-home usage of water and a likely place for hazardous or toxic substances to enter the water cycle.

WHAT IS TOXIC or HAZARDOUS?

A material is **hazardous** if it is **radioactive, corrosive, flammable, reactive, or toxic.**

Corrosive substances can eat away the surface of another material. Some examples of corrosive materials in the home are oven cleaners and bathroom cleaners.

Reactive materials are very unstable and can react with air, water, or another substance to produce toxic vapors or to explode. Some examples of reactive materials in the home are ammonia-based cleaners and bleach-based cleaners.

Flammable materials will ignite, or burst into flames. Examples of ignitable materials found in the home are nail polish, paint remover and hair spray.

Radioactive materials can damage or destroy cells and chromosomal material. Some smoke detectors contain small amounts of radioactive materials.

Toxic materials cause immediate or long term health problems. Exposure to toxic materials may result in injury, illness or death. Examples of toxic materials found in the home are paint stripper, pesticides and wood preservatives.

The Federal Hazardous Substance Act requires that the signal words "**caution, warning and danger**" appear on labels of products containing hazardous substances.

Danger means the substance is highly toxic: one drop to one teaspoon is fatal.

Warning means it is moderately toxic: one tsp. to one ounce is a fatal dose.

Caution means that the product is low in toxicity: over one ounce is a fatal dose. The doses are based on an "average" 150 pound adult.(5)(6)

The Path of Water in the Flush

After an initial flush of the toilet, the water and waste head for the waste water treatment plant or the septic system.

At the treatment plant, the first step is removal of large solids (like big wads of toilet paper) with large bar screens. This debris is usually sent to a landfill.

The "screened" sewage is then sent to primary settling tanks, where fecal matter and other solids settle on the bottom. This settled matter is called "primary sludge".

Next, liquid from the primary settling tanks flows into deep aeration tanks. Diffused air keeps millions of aerobic bacteria happily feeding on soluble organic matter and also multiplying very rapidly. This mass of reproducing microorganisms then flows into secondary settling tanks where most of them settle to the bottom as "secondary sludge." Some are returned to the aeration tanks as "seed" for the next generation of microbes and the rest proceed to sludge digesters.

More water is then removed from the sludge in the primary and secondary settling tanks and is returned to the beginning of the process. The remaining sludge is placed in "digesters" where anaerobic bacteria work on decomposition. Depending on the area, sludge is either applied to land for fertilizer, burned in incinerators, or buried in landfills.

Meanwhile, the liquid, or secondary effluent goes to yet another series of tanks where it is disinfected with chlorine. At this point the liquid is dechlorinated and is ready to re-enter the water cycle to once again be used for human consumption.

If waste water is flushed into a septic tank this process is slightly different. Solids settle to the bottom in the tank where bacteria, found in the waste, digest organic compounds. Waste water leaves the tank and drains into the leach field. (5)

The leach field consists of perforated distribution pipes, which distribute the waste water beneath the ground's surface into the surrounding soil. Microorganisms, living in the soil, break down the waste further. Periodically septic tanks are pumped out and the septage is taken to a municipal waste water treatment plant or to a landfill. (5)

Hazardous substances in the water supply are capable of destroying the bacteria so vital to the cleaning process and are very difficult to remove from the water system, especially in large quantities.

Besides entering the water supply through drains, toilets and bathtubs, water contaminated with hazardous wastes from the home can also return to rivers and streams via the street storm drains outside our homes. These storm drains typically by-pass any type of treatment and enter directly into the water supply.

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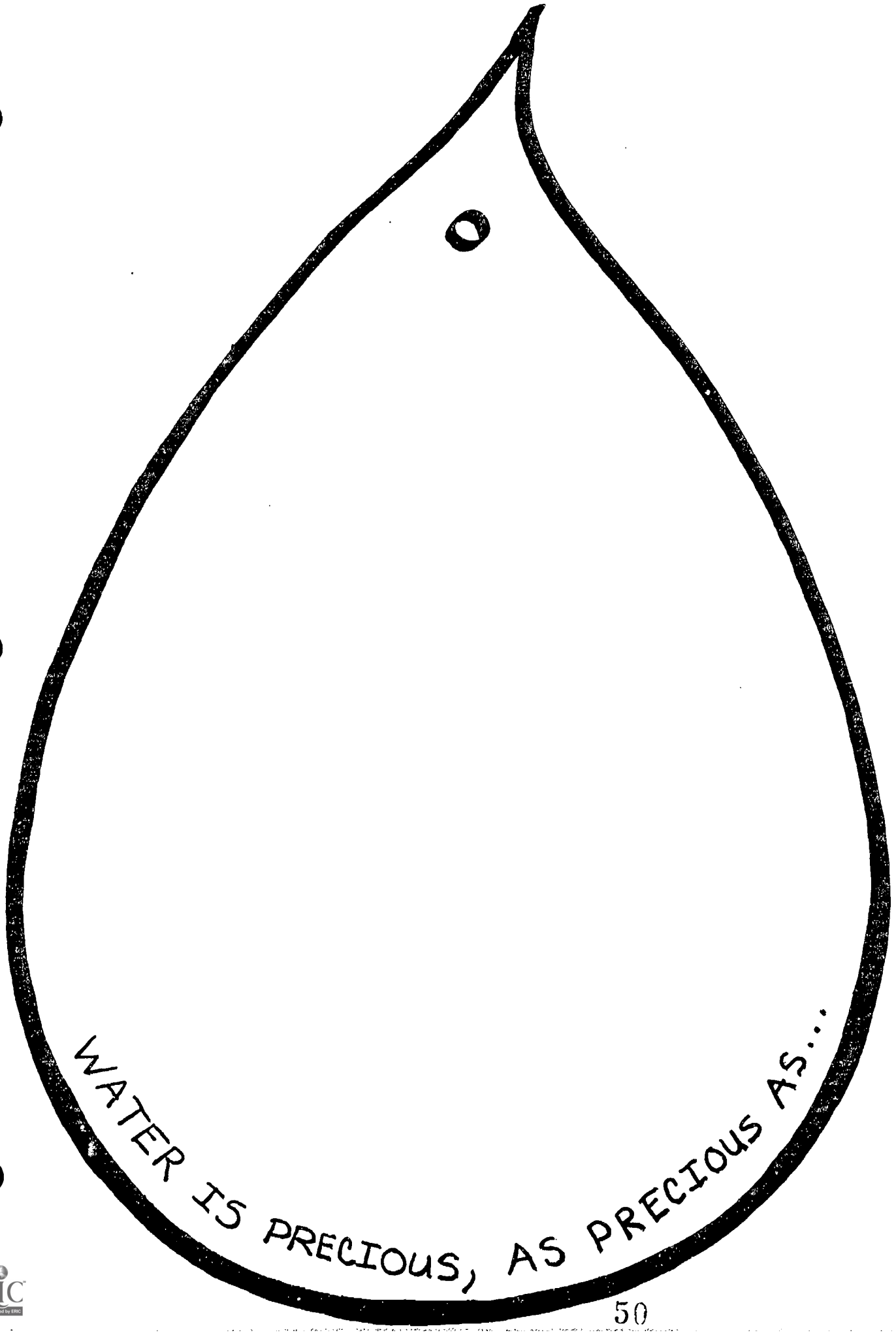
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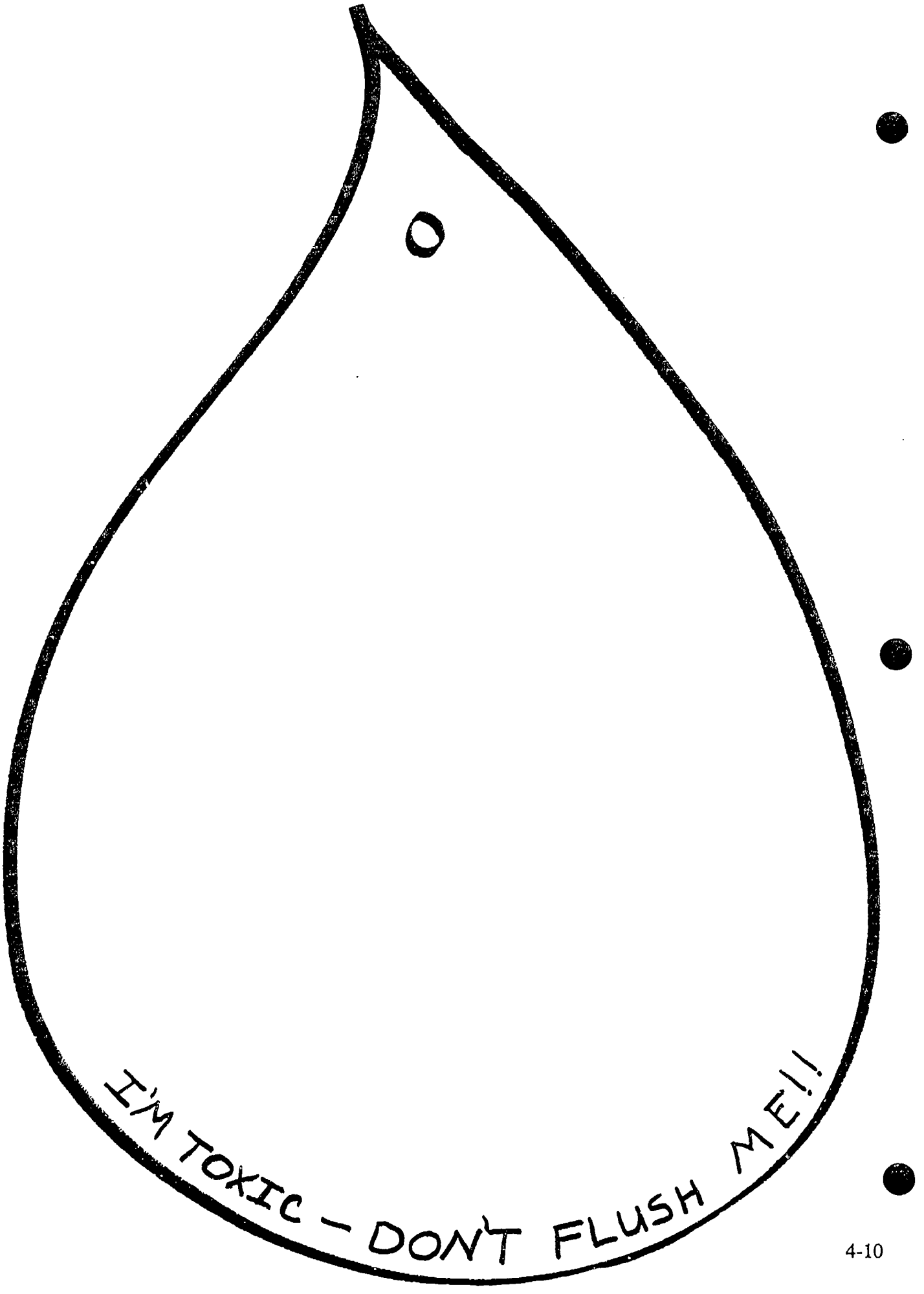
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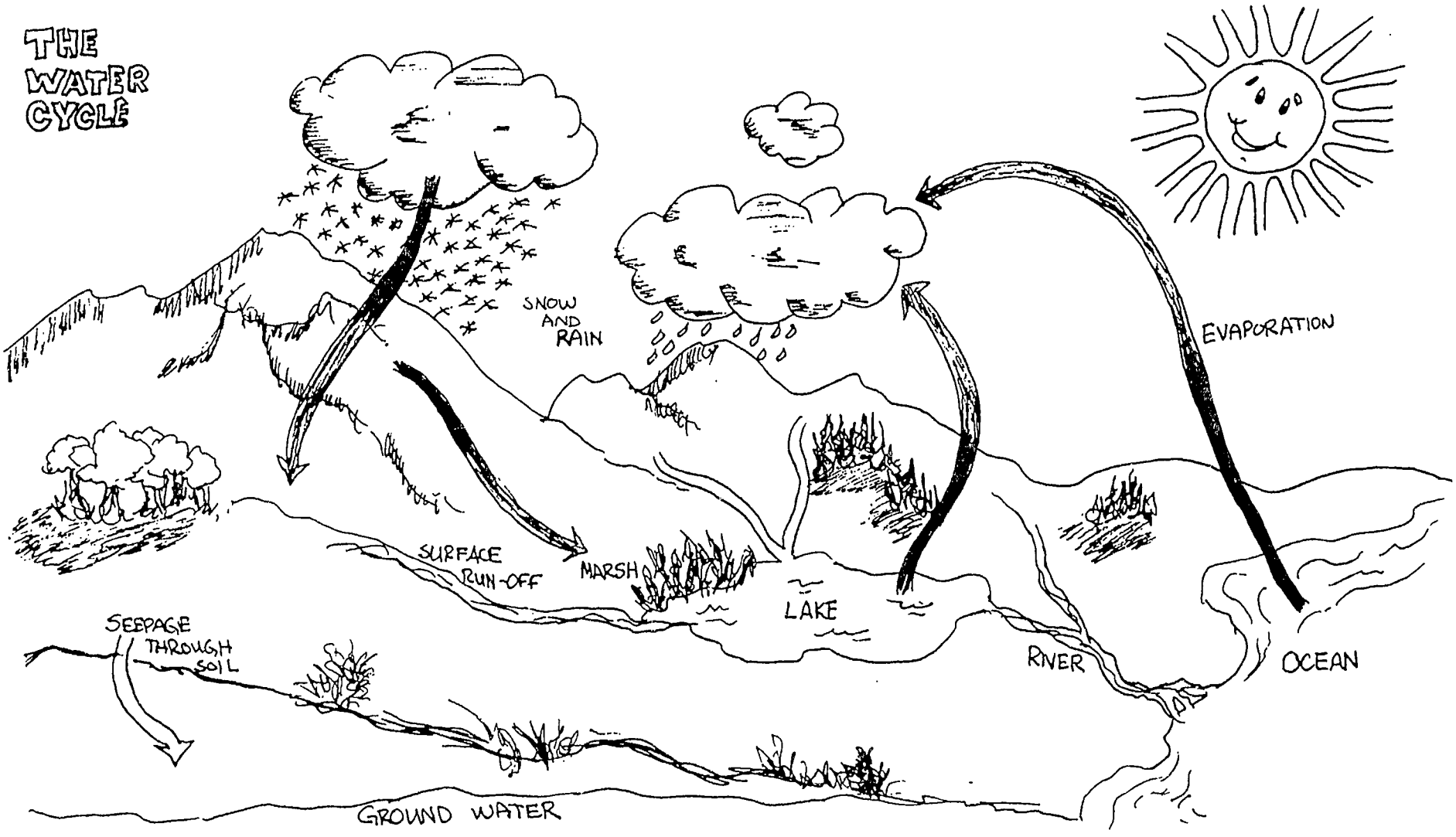
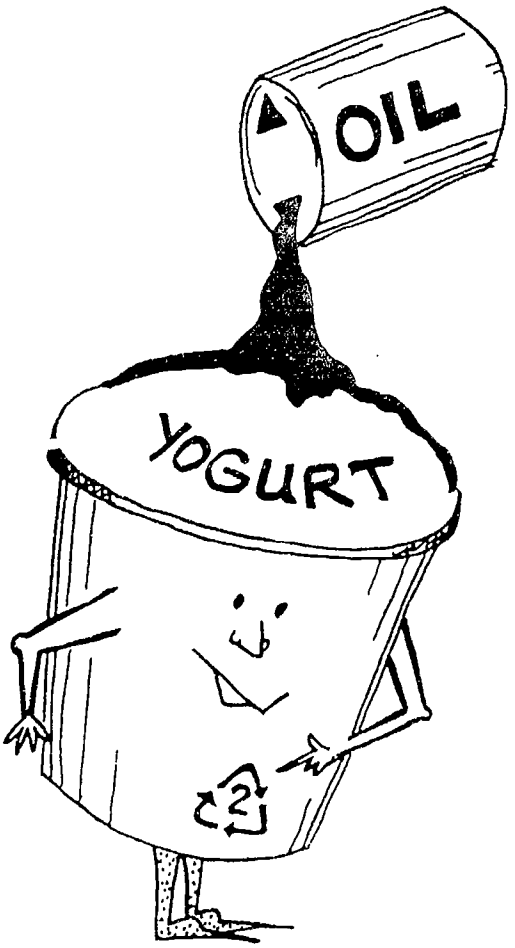

THE WATER CYCLE
SNOW AND RAIN
EVAPORATION
SURFACE RUN-OFF
MARSH
LAKE
RIVER
OCEAN
SEEPAGE THROUGH SOIL
GROUND WATER

"HOW TO DRESS A DINOSAUR: FROM OIL, TO YOGURT, TO..."



The Life Cycle of a Yogurt Container

"HOW TO DRESS A DINOSAUR: FROM OIL, TO YOGURT,TO ...?"

SUBJECTS: Science, Social Studies, Movement Exploration, Art, Drama

GRADES: 3-6

ACADEMIC SKILLS: Analysis, application, classification, comparing similarities and differences, critical thinking, evaluation, kinesthetic concept development, listing, observation, problem solving, psychomotor, synthesis

TIME: Three 45-minute class periods

MATERIALS: 8 1/2" x 11" white paper or lightweight cardboard, crayons, paints or markers, hole punch, string, sample recycle symbols, sticky backed paper or small sheets of paper and tape (for making recycling symbols and putting on bottoms of shoes), paper for product names during "At the Plastic Container Plant", a variety of empty yogurt containers which have different numbered symbols on the bottoms, music for dance of the oil pump (suggestions: heavy metal with a slow beat, or rap with an environmental message), overhead of life cycle of yogurt containers (See attached.)

VOCABULARY: Labeling, advertising, recycling codes, HDPE, PS, PP

CONCEPT: Plastic comes from oil. As plastic consumers, we are indirectly responsible for all environmental impacts associated with the life cycle of plastic including: drilling and transportation of oil; pollution caused by oil refining and plastic manufacture; and the creation of non-biodegradable solid waste when plastic is disposed of, if it is not recycled. The use of plastic also contributes to the depletion of oil, a non-renewable resource.

OBJECTIVE: Students will be able to make choices in purchasing that reflect awareness of the life cycle of plastic. Students will be able to identify recycle coding symbols on plastic containers and determine which are recyclable in their area. Through student awareness and possible resultant action regarding this responsibility, the demand for non-recyclable plastics may decrease. Students will also examine how the power of label advertising heavily influences their choices in the buying process.

BACKGROUND: (See attached.)

ACTIVITIES:

Discussion

Ask the children what material a yogurt container is made from. Ask where plastic comes from. Discuss with the children the history of plastic from the age of the dinosaur. (See overhead and teacher background information regarding the oil industry and processing of plastic.)

Scheduling and Student Preparation

During the course of these activities, students will examine all stages of the life cycle of a plastic yogurt container. These activities can be carried out all in one day, or the dance and art activities can be scheduled for one day, and the grocery store exercise can be the following day. In either case, on the day before the grocery store activity, send a note home for the parents instructing the students to come dressed in dark shirts and pants or dresses. Also ask them to bring their favorite colorful T-shirt, one that can easily be slipped over their dark clothes. In the note, also invite the parents to come at the appropriate time to participate in the grocery store activity.

Classroom Set-Up

Mark off five areas and make large signs to delineate the following areas:

1.) the oil field and refinery
2.) the yogurt container manufacturing plant
3.) a grocery store
4.) a recycle area
5.) a landfill space

This can be a very elaborate class project with visual aids and art decorations on the walls, or it can simply be areas marked off with tape on the floor.

Dance of the Oil and the Oil Pump

The students will be dressed in their dark outfits for this exercise to serve as a reminder of the beginnings of the plastic container's life cycle.

Turn on the music and ask the children to lay on the ground and pretend that they are a puddle of oil, oozing around. Then ask them if they have ever seen an oil pumping system, if so ask them to imitate the motion they have seen. If not, demonstrate to them an oil pump working in a field. (An oil pump is a very stiff action: bend from the waist, with arms and hands together pointing stiffly to the ground. Slowly and rhythmically bend up and down. For more complicated movements, arms can remain in a bent position, going in a synchronized, stiff, forward circular motion at the same time the head and trunk of the body are bobbing up and down.) After the oil has been pumped, ask the students to pretend to transport the oil to the refinery and then to the plastic factory. (Students can imitate trucks, ocean going ships, or a pipe line.)

Art Activities:

At The Plastic Container Plant: Not All Plastics Are Created Equal

Most yogurt containers are marked on the bottom with a #2, #5 or #6, inside the triangular chasing arrow symbol. (#2 is recyclable in most areas of the country. #5 and #6 are not recyclable in most areas of the country. If you do not know what is recyclable in your area, be sure to check.) In addition, some plastic yogurt containers are not marked with the chasing arrow symbol. These are not recyclable anywhere, because the type of plastic used is not identified.

Draw pictures of the recycling symbols on the board. Then, in a random manner, assign students to make a small #2, #5 or #6 inside the chasing arrow symbol which they will tape to the bottom of their shoe for the next activity.

Before or during this art activity, conduct the following discussion.

1. Look at the bottom of a yogurt container. What does the triangular symbol mean? What are the numbers?

2. Are all these containers recyclable? Will some of the containers go to the landfill?

3. Using the teacher background material, discuss what products can be made from recycled plastic. Have students print the name of these products on separate sheets of 8 1/2" x 11" paper or cardboard. Set these aside for the end activity "At the Grocery Store".

Becoming Beautiful at the Yogurt Container Plant

Using any art medium you desire, have each student produce a label that contains a tantalizing image of yogurt and which uses no more than three words. The label will be worn as a necklace, using a hole punch and string.

Prior to the time when students are creating their labels, discuss the following questions.

1. When you are in the store, what packaging attracts your attention? What colors do you like?

2. Does the size of packaging draw your attention? Have you ever purchased something that looked larger than it was because of the package size?

3. Showing some sample yogurt containers, ask: Which yogurt would you buy? Why?

At the Grocery Store

This is the point at which the students adorn themselves with their colored T-shirts, attractive label necklaces and recycling stickers. Ask students to align themselves as if they are rows of yogurt on a store shelf. When the students are ready, invite parents, teachers, principals, or other students to enter the room and act as yogurt consumers.

The consumers now go shopping. They shop according to labels (as do most people). The "yogurt kids" go with the consumer, get consumed and are then disposed of or recycled depending on the sticker placed on the bottom of their shoes. Keeping score on the chalk board, give the consumers a positive score for each recyclable yogurt container they buy and a negative score for each non-recyclable yogurt container they buy.

The non-recyclable yogurt containers stack up in the landfill. If they are recyclable yogurt containers, the students may remove their recycle sticker from their shoe and go back to pick up a sign of a product which can be made from recycled HDPE, such as a plastic picnic bench, boat dock, plastic bag or parking lot stop. Then they may return to the shelf in the store holding their signs. Then ask the consumers to purchase the recycled items. After the recycled item kids are purchased, have them go stand by the consumer.

When all the "yogurt kids" are eaten and all the recycled items are purchased, the activity is finished. Explain that even though most recycled plastic items are very durable, they usually cannot be recycled again. When they are broken or worn out, they go to the landfill or an incinerator.

Finally, ask the students to take off their pretty label necklaces and colorful shirts to reveal their dark clothes, representing oil, underneath. Discuss with the students what happens to plastic containers in the landfill. (Nothing, petroleum based plastic is non-biodegradable.)

EXTENSIONS:

1. For further movement exercises, have the students act out different types of stiff, mechanical actions that might mimic machines in the yogurt container manufacturing company.

2. Design a new yogurt container label that would praise the consumer's choice of buying a recyclable container, as well as draw their attention to the product.

3. Brainstorm the perfect, recyclable yogurt container of the future. What would it look like? What would it be made of?

4. Have the students create uses for non-recyclable plastic containers. (Flower pots for mother's day, string telephones, paint containers, bug boxes, storage, etc.)

5. Have students write to the yogurt companies that are using non-recyclable plastic containers. Addresses for the companies are usually found on the container label. If not, ask the store managers.

6. Many stores have comment boxes. Students could fill out comment sheets based on their preference in packaging.

BACKGROUND INFORMATION:

Note to the Teacher: This background information is similar to that in the exercise entitled: "It's Not Really Horse Power Anymore," since gasoline and plastics are both petroleum derived products.

Geologic History of Oil and Natural Gas

The chemical components of today's plastics originate from petroleum products such as oil, natural gas and coal. The theory is that oil and natural gas were formed as millions of aquatic plants and animals died, decayed and then slowly drifted to the bottom of the seas. Here they were covered up by layers of sand, water, rock and mud. Besides layering due to wind, major changes occurred in the earth's crust over the last few hundred million years due to natural events such as floods, volcanic eruptions, landslides and earthquakes. Sometimes oceans covered vast areas which are now dry land and vice versa. The decaying plants and animals were compressed by the weight of all the layers which formed on top of them. This pressure created extreme amounts of heat. Because of the heat and pressure, as well as some bacterial action, chemical changes caused the remains of these creatures to turn into crude oil and gas.(1)

Once oil and gas were formed, they moved through porous rock until they reached non-porous layers. There they accumulated in "traps" or pockets. The gas collected in the upper areas of the pockets and the crude oil settled to the bottoms.(1)

Oil in Modern Times

Geologists use sound waves to detect oil traps. Drilling rigs tap into these traps and usually pump out the gas first. Then the oil is removed and transported to refineries.(4)

Sometimes accidents occur during the transportation of oil and oil spills result. After a shoreline spill, it can take decades for the environment to recover. Large animals and birds get coated with oil and are killed, or eat the oil and die from poisoning. Some of the oil dissolves in the water and is absorbed into the tissue of plants and animals. Then it is passed along in the food chain, even up to humans who eat fish or shellfish. Compounds in the oil can cause cancer or mutations in various life forms.(4) *Even though oil spills are serious, many more times the oil spilled accidentally, is dumped on the ground or down storm drains by people who change their own automobile oil at home.*

Processing

When oil safely reaches the refinery, this "petrochemical soup," which is called crude oil, is processed by chemical weight into different products. Some of the products produced are gasoline, solvents, jet fuel, kerosene, heating and diesel fuel, industrial oils, waxes, lubricating oils, greases, and petroleum coke. These products can be further refined into plastics, pesticides, fertilizers, synthetic fabrics, acids, cleaning fluids and asphalt.(1)

Additional Environmental Concerns

Oil is the main energy resource for the industrialized world; and the reserves of this resource are limited. A consequence of using this energy source is the pollution it causes. When engines burn gasoline or other petroleum fuels, they release toxic gases and other waste products into the air. These substances can cause respiratory diseases, cancer and other health problems. They can also contribute to acid rain and global climate change.(2)

Geologic History of Coal

Coal was formed in much the same way as oil. It came from plants and animals that lived on land or in swamps even before the dinosaurs. The decay of these creatures first formed peat, then coal. It took as much as 10 feet of plant material to make one foot of coal.(5)

Use in Modern Times

Coal is mined and then loaded in small coal cars or conveyer belts which carry it outside to huge trucks. Then the coal is taken to a plant where it is crushed into small pieces. Finally, coal is transported by truck, railroad car, barge, or sometimes is mixed with oil or water and sent by pipeline to the user.(4)

Unlike oil, coal is plentiful. Coal deposits are found in 38 of 50 states; and one quarter of all known coal deposits in the world are found in the United States.(5) Like oil, using coal can also have detrimental effects on the environment. Some areas of the country are surface mined, leaving ugly scars on the environment. Although by law strip-mined areas must be reclaimed, it is often very difficult to revegetate these areas.(4)

Environmental Concerns

Air pollution is the primary concern when burning coal. Sulfur and nitrogen oxides, which have been associated with acid rain, are released into the atmosphere when coal is burned. In the 1940s and 50s, where coal was used in large amounts, the air was often filled with soot and foul odors.(4) But cleaner technologies for burning coal are currently available, largely because Congress began the "Clean Coal Technology Program" and set aside hundreds of millions of dollars in 1986 to study coal fuel technology.(5)

Plastics

Although some experimentation is being performed to make plastics out of starch and sugar, most plastics today are formed from petrochemicals such as ethylene, benzene and propylene. These chemicals all come from coal, oil and natural gas. When processed, these chemicals form the basic components of plastics.(6)

Plastic Codes and Recycling

The Society of the Plastics Industry (SPI) has created a plastics coding system to assist recyclers with the identification of different types of plastics. (See attached plastics chart.) *This code is only a guide to the type of plastic used. It does not mean the container is recyclable.* For plastics to be recycled, a collection and transportation system must exist for each type of plastic. In addition, a remanufacturer must exist for the collected materials.

In 1990, only about two percent of the plastics generated in municipal solid waste were recovered for recycling. The remaining material, almost 16 million tons, was discarded in landfills or incinerated. Plastics comprised almost 21 percent of the volume of materials landfilled in 1990.(7)

Yogurt Containers

Yogurt containers are usually made from SPI #2 High Density Polyethylene (HDPE) plastic, SPI #5 Polypropylene (PP), or SPI #6 Polystyrene (PS) plastic.(6)

Avid recyclers know that #2 HDPE appears on the bottom of most milk and water plastic bottles. Although this is the same material that some yogurt containers are made of, these small-necked, pouring-type bottles are made in a different process called *blow molding*. Recognizing the distinctions between these processes is important for recyclers because the two kinds of HDPE melt at different temperatures and are incompatible for some recycling operations. Typically, the naturally-colored milk and water jugs bring higher prices to the recycle center if they are recycled separately from other colored HDPE containers.

Polypropylene (PP) is used in a variety of consumer products such as fibers, films, screw-on caps, drinking straws, diapers and lead-acid battery casings. Because of the diversity of products produced from PP, it's difficult to gather enough quantity to justify a separate collection program. Forty percent of all PP collected and recycled is from used battery casings.

Polystyrene (PS) food containers are recycled in very few areas of the United States. In 1992, less than one percent of the polystyrene made in the U.S. was recycled. Polystyrene is also known as "styrofoam" when it is processed into a foam material.(7)

The following chart lists some of the products which are made from remanufactured HDPE, PP and PS.

COMMON PRODUCTS MADE FROM RECYCLED HDPE, PP AND PS (7)

HDPE	PP	PS
--detergent and motor oil bottles --trash cans --recycling bins --soda bottle base cups --drainage pipes --animal pens --drums and pails --floor matting --nursery pots --pallets --bathroom stalls --plastic lumber --golf bag liners --kitchen drain boards --traffic cones --hair combs --frisbees and yoyos	--battery cases --auto parts --outdoor furniture --plastic lumber --pails --wheels for BBQ grills and lawn mowers --golf equipment --carpeting --trash and recycling containers --grocery cart handles --industrial fibers	--foam packaging products --reusable serving trays --flower pots --plastic lumber --insulation board --carpet fibers --video cassettes --trash containers --rulers and other office accessories --license plate frames

PLASTIC CONTAINER RECYCLING, 1992 (7)

PLASTIC RESIN TYPE	% OF TOTAL PLASTIC PACKAGING-1992 BY WEIGHT	% OF PLASTIC TYPE RECYCLED 1992 BY SALES
 PET (Polyethylene Terephthalate)	10%	27%
 HDPE (High Density Polyethylene)	27%	10%
 PVC (Polyvinyl Chloride)	5%	1.4%
 LDPE (Low Density Polyethylene)	33%	1.3%
 PP (Polypropylene)	10%	1%
 PS (Polystyrene)	15%	1.5%
 Other Resins and Mixed Plastics	Not generally used in packaging	Not generally recycled in 1993

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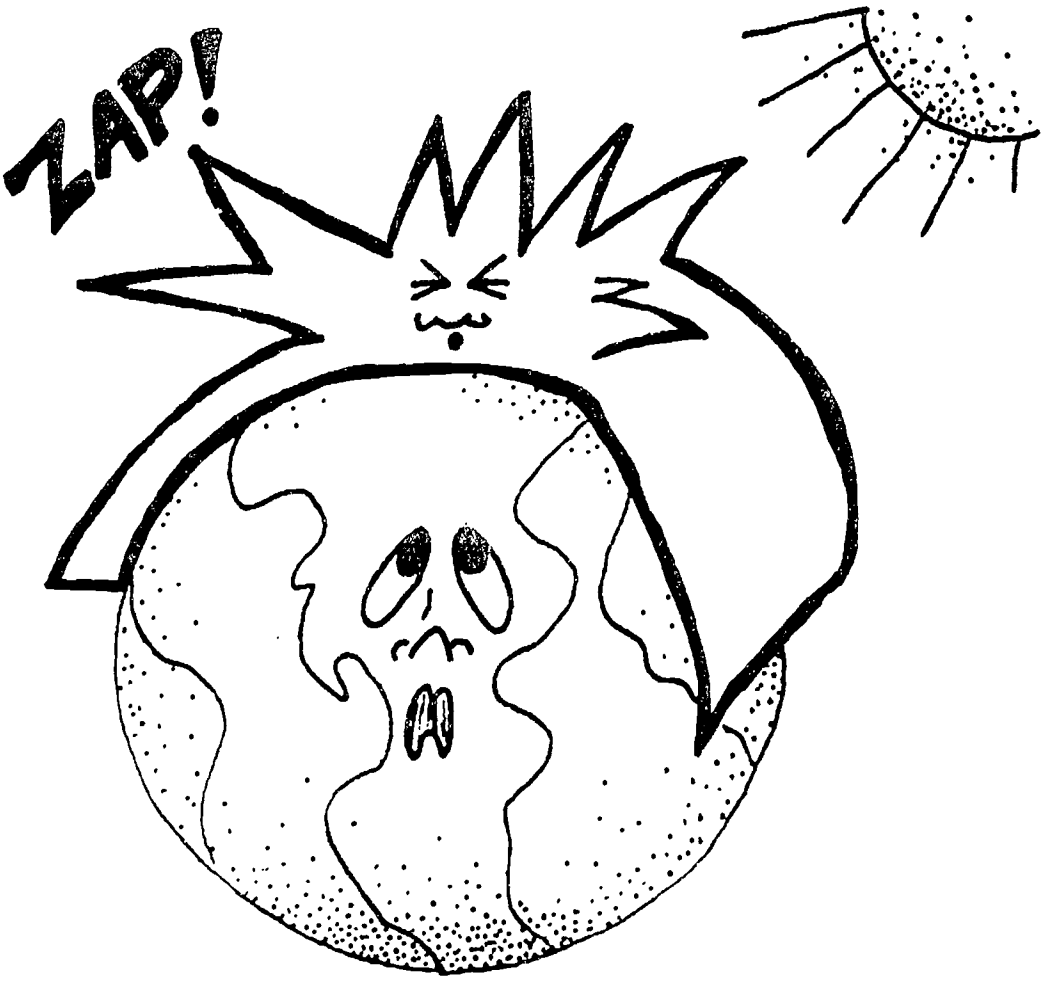
PLASTIC CONTAINERS
YOGUR
TGURT
YOG

"ZAP! GOES THE OZONE"



The Life Cycle of Ozone

"ZAP! GOES THE OZONE!"

SUBJECTS: Science, Math, Geometry, Language Arts, Movement Exploration

GRADES: 4-6

ACADEMIC SKILLS: Analysis, applicati n, construction, critical thinking, kinesthetic concept development, listing, media construction, reading

TIME: One or two 45 minute class periods

MATERIALS: Round cardboard pizza liners or other cardboard for 18" round "shields" for each student, butcher paper or wax paper or other white paper large enough to cover shields, approximately 1 foot of small diameter rope or cord for each student, lamp with at least a 100 watt bulb (optional), colored paper, glue, "Save the Shield" game cards (laminated if possible), Ranger Rick copy cat page "Holey Ozone" made into an overhead (See attached.)

VOCABULARY: Ozone, CFCs, HCFCs, freon, atmosphere, troposphere, stratosphere, consequence, solvents, halons

CONCEPT: Life as we know it is possible in part because of the protective ozone in the upper atmosphere which shields the earth from the sun's dangerous ultra-violet rays. Since the 1970s, it has become clear to scientists and governments that human activity is threatening our ozone shield.

OBJECTIVE: Students will be able to explain: the importance of protecting the ozone layer; some of the causes of ozone destruction; and possible methods of preventing further ozone depletion. Each student will construct their own ozone shield and then either cut holes in it, or glue patches to it in response to game cards read to the class.

BACKGROUND: (See attached.)

ACTIVITIES:

Discussion

Ask the students what they know or have heard about the ozone layer. Then, using the background material, including the Ranger Rick overhead, discuss with them how ozone is formed and how it is destroyed.

Ozone Shields

Shields can be made as a classroom project with the teacher providing all the materials, or as a homework assignment for each student. If round, cardboard pizza liners are not available, instruct the students to cut an 18" diameter circle out of cardboard. This circle can be easily drawn by making a primitive compass. Tie a 9 inch string between two pencils. Place one pencil in the center of a piece of cardboard and draw the outline of the large 18 inch circle with the other pencil. Or, for younger grades, a template can be made by the teacher for the students to trace.

Add a strap to each shield to fit generously around the students' hands. (See illustration A.) The straps are best secured by poking holes through the shields with pens and then tying the rope or cord into a knot on the other side on the cardboard. (See illustration B.) The cardboard shield represents the atmosphere.

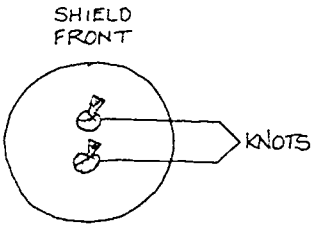


Illustration A

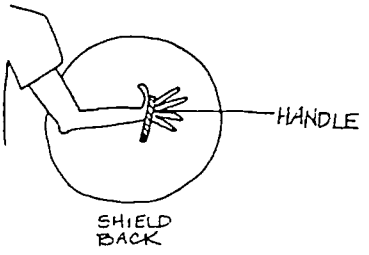


Illustration B

Once the cardboard shield is finished, cut out another circle of the same size from white or wax paper. The students will use this paper to represent the ozone layer and will draw and cut geometric shapes from it to represent ozone eating consequences described in the game cards. After the game, the students will glue the white sheet, complete with holes, onto the cardboard. The students will also need colored sheets of paper to act as "patch" material for their ozone shields. They will prepare patches from the colored paper and glue them onto the shield at the end of the game, after the white "ozone layer" is glued onto the cardboard.

Save the Shield: A Game About The Ozone Layer

In this game, ten students will be asked to choose a game card and read it to the rest of the class. The student can either read both sides of the cards, or the teacher can read the consequence side of the card and direct the class to make the appropriate geometric "hole" or "patch" for the ozone shields.

To end the game ask the students to paste the "ozone layer" to the shield and patch what holes they can with their ozone patches. Then ask the students to go outside, stand in a circle and hold their shields between themselves and the sun. If you can't go outside, set up a bright light and finish the exercise indoors. Ask each one to read what they wrote in response to game card #10, concerning what they want to protect and how they will help save the ozone. Then sing the song "Zap Goes The Ozone" to the tune of "Pop Goes the Weasel."

ZAP GOES THE OZONE!

All around the roof of the world,
The CFC chased the Ozone,
The CFC stopped to soak up the sun,
ZAP goes the Ozone.

EXTENSIONS:

1. Hang an automotive "trouble light" with a high intensity bulb in the corner of the classroom to represent the sun. After the completion of the game, hang the ozone shields from the ceiling in front of the artificial sun.

2. Display the shields elsewhere in the school.

3. Calculate all of the future generations in the students' families who will be adversely affected by the loss of ozone caused by actions taking place in this year. (CFC-12 can persist in the atmosphere for 139 years. If a generation is 25 years, their great, great, great, great grandchildren will be affected.)

4. Research businesses in your community that recycle freon from refrigerators and air conditioning units. Start with appliance repair shops.

5. (For advanced students) Calculate the total square inches of the "patches" and the "holes" in this exercise and then subtract the difference between them from the area of the shield. Determine what percentage of the shield was destroyed. Then multiply this percentage by two to equal the percentage of new cases of skin cancer which can be expected by this amount of loss to the ozone. Then multiply this percentage by the total number of students in the school to see how many persons in their school may be affected.

6. Write a classroom letter to the president of one of the companies listed below who are or were producing CFCs.

E.I Du Pont de Nemours & Co., Inc.
1007 Market Street
Wilmington, DE 19898

Allied-Signal Inc.
Columbia Road & Park Avenue
P.O. Box 3000R
Morristown, NJ 07960

Pennwalt Corporation
Three Parkway
Philadelphia, PA 19102

LaRoche Chemical, Inc.
P.O. Box 1031
Baton Rouge, LA 70821

Racon Inc.
6040 S. Ridge Road
P.O. Box 196
Wichita, KS 67201

BACKGROUND INFORMATION:

> Orbiting above the Earth, an astronaut can look down on our home and see the thin blue ribbon that rims our planet. That transparent blanket--our atmosphere--makes life possible. It provides the air we breathe and regulates our global temperature. And it contains a special ingredient called ozone that filters deadly solar radiation.(1)
>
> "For the first time in my life I saw the horizon as a curved line. It was accentuated by a thin seam of dark blue light, our atmosphere. Obviously this was not the ocean of air I had been told it was so many times in my life. I was terrified by its fragile appearance."
>
> - Ulf Merbold, German Astronaut.(1)

The Ozone Layer

Although ozone molecules play a vital role in the upper atmosphere, that of filtering out dangerous ultraviolet-B radiation(2), they are exceedingly rare. Fewer than ten out of every million molecules of air in the upper atmosphere, called the stratosphere, are ozone.(1) In the lower atmosphere, called the troposphere, low lying ozone is the main component of smog. Ground level ozone retards crop and tree growth, limits visibility and damages lung functions.(2) So ozone is either a friend or a foe, depending on where it occurs in the atmosphere.

The word "ozone" comes from the Greek word meaning "smell," a reference to ozone's distinctively pungent odor. This is the odor most associated with a lightning storm. The sharp, peculiar odor in the air following a lightning strike is the smell of ozone.

The recipe for making ozone in the upper atmosphere starts off with oxygen molecules (O_2). When an ozone molecule absorbs ultra-violet (UV) light, the molecule splits apart into two single oxygen atoms (O) which are exceedingly unstable. Within a fraction of a second, the atoms bond with nearby oxygen molecules to form ozone (O_3). These molecules are also unstable and react quickly with compounds containing nitrogen, hydrogen, chlorine or bromine. For about a billion years, the delicate balance of ozone creation and destruction functioned smoothly. But now, humans have upset the delicate balance by polluting the atmosphere with additional chlorine and bromine containing chemicals, thus causing the level of ozone in the stratosphere to decrease.(1)

Tanned, leathered and wrinkled skin are all caused by ultraviolet radiation. Loss in atmospheric ozone will cause an increase in skin cancer in light-skinned people and more cataracts in eyes. Dermatologists assess that for every decrease of 1 percent in the ozone layer, there is a 2 percent increase in the incidence of skin cancer. Melanoma, a type of skin cancer that can be fatal if not treated, is now diagnosed at the rate of 1 in 128 Americans, an increase of about 1,500 percent since 1935, according to Dr. Darrell S. Rigel of New York University Medical School.(2)

Ultraviolet B rays can also damage DNA and cause genetic defects. They have been linked to weakened immune systems in humans and animals, can damage crops, floating fish eggs and phytoplankton--the microscopic plants that form the basis of the food chain in the ocean.(2)

In addition to destroying the ozone layer, chlorine containing compounds, called CFCs (chlorofluorocarbons) or "freons", are gases which contribute to the threat of global warming. When they escape into the atmosphere, most CFC molecules trap 20,000 times more heat than carbon dioxide molecules(3) and each chlorine atom could destroy 100,000 ozone molecules(1). While CFCs were once thought to epitomize the saying "A Better World Through Chemistry," they have caused a global atmospheric problem.

CFCs

CFCs were developed in the 1920s by the Du Pont Company and the Frigidaire Division of General Motors to be used in the newly introduced refrigerators that were replacing ice boxes. (Ice boxes literally held big blocks of ice, cut from rivers or lakes and stored for year-long use, prior to modern refrigeration.) This miracle chemical was non-toxic to humans, nonflammable, noncorrosive and stable, making it excellent for domestic use. Surprisingly, four to five times as many CFCs are used in the foam insulation in refrigerators, as are in the cooling system.(4)

Over the years, CFCs production expanded to become a multibillion dollar business. CFCs are now used in refrigerators, air conditioning in the home, car and commercial air conditioners, propellants in aerosol spray cans, cleaning solvents for the electronics industry, rigid foams for packaging and insulation and flexible foams for mattresses, furniture and car seats.

One type of CFC, called CFC-12, which is responsible for an estimated 45 percent of ozone depletion, has an atmospheric lifetime of 139 years. CFC-12 is used in air conditioning, refrigeration, aerosols and foams. It may take decades for CFCs to reach the upper atmosphere where they are zapped by ultraviolet light and become ozone eaters.(5) So even if use of CFCs were discontinued immediately, the damage from past usage could continue for over one hundred years in the future.(2)

The Ozone and Environmental Action

Global concern about ozone depletion marked a truly profound moment in human history. In September 1987, diplomats from around the world met in Montreal, Canada and forged a treaty unprecedented in the history of international negotiations. Representatives from most of the industrialized world agreed to set sharp limits on the use of ozone depleting chemicals.

The treaty, called the Montreal Protocol established new ways of dealing with global environmental problems. The negotiators were motivated by concerns about *future* ozone loss. In the past, the world had addressed environmental issues only *after* environmental damage grew noticeable. Negotiations on this issue marked the first time the nations of the world have joined forces to protect the Earth for future generations.

Further research in the late 1980's revealed that the original Montreal Protocol would not go far enough toward protecting the fragile ozone layer. In June 1990, diplomats met in London and voted to significantly strengthen the Montreal Protocol. This treaty calls for a complete phaseout of CFCs by the year 2000 and a similar phaseout of other ozone depleting chemicals shortly thereafter.(1)

However, even with these treaties, Australian scientists predicted that between 1980 and 2005 Australia will suffer increases in ultraviolet radiation ranging from 9.7 percent in Sydney to 18 percent in Hobart, Tasmania. Canada's Atmospheric Environment Service reports that levels of stratospheric ozone over southern Canada in Spring 1990 were 8 percent lower than the springtime average for the past 25 years.(6)

A study released in April, 1991 by the US Environmental Protection Agency shows that ozone depletion was occurring at double the rate of previous estimates and an additional 5000 Americans were predicted to die each year from skin cancer because of the increases in ultraviolet radiation.(6)

In October 1991, scientists working under United Nations auspices reported for the first time depletion of the ozone layer in the summer in the latitudes of the United States. As a result, in November, 1991, the deadlines for phasing out CFCs were moved up to 1995; and halon manufacture was to end of 1993. However, other ozone-destroying chemicals such as bromine containing pesticides were not fully regulated. In addition, some of the CFC replacements, such as HCFCs, also destroy ozone, although at a much lower rate.(7)

In August, 1993, the National Oceanic And Atmospheric Administration's climate diagnostics laboratory in Boulder, Colorado, reported that the build up of ozone destroying chemicals was still increasing, but at a much slower rate. This was one of the first indicators that previous ozone-saving measures may be working.(7)

The problems the world faces due to ozone depletion are serious and have no simple answers. However, some of the answers to avoidance of future ozone depletion are explored in the game in this lesson entitled "Save the Shield."

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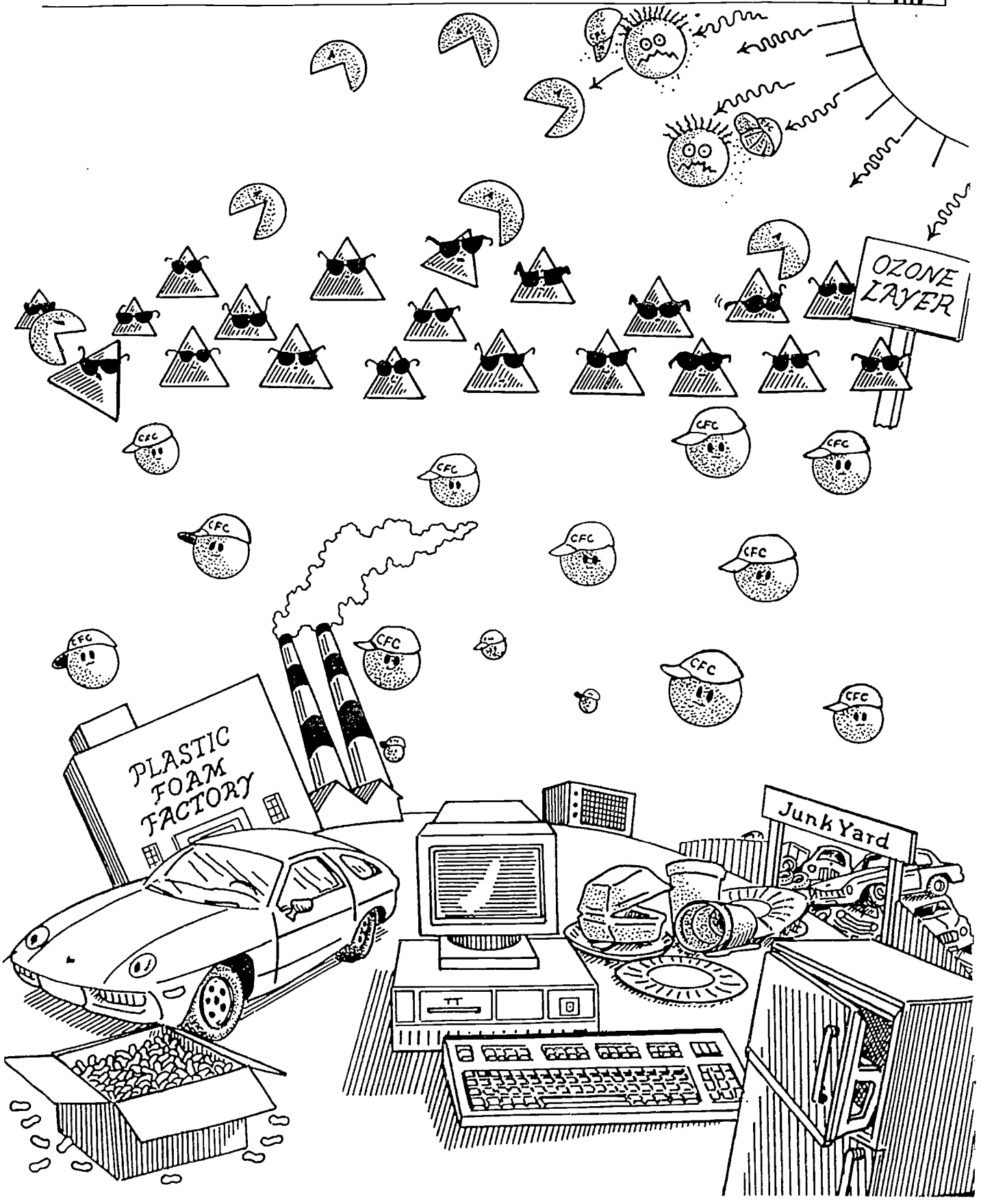

OZONE LAYER
CFC
PLASTIC FOAM FACTORY
Junk Yard

SAVE THE SHIELD GAME CARDS--SIDE 1

Story: Alfonzo was helping his father build a shop onto the garage. When they went to buy insulation, he talked his father into buying fiberglass insulation instead of the rigid foam insulation, because he knew that the rigid foam was made with ozone destroying chemicals. They also chose to insulate the ceiling with cellulose insulation made from recycled newspapers.

-1-

Story: Daphne and Chuck's father works for a dry cleaning store. Their dad is constantly saying that the cleaners have really old equipment that needs to be replaced. Their mom works in a computer plant where part of her job is to clean computer parts.

-2-

Story: Sarah and her mom, Sue, went to the hardware store to buy a fire extinguisher for their kitchen. They saw that some fire extinguishers had dry chemicals and some "New and Improved" ones had "halons" in them. Sue bought the "New and Improved" fire extinguisher and took it home.

-3-

Story: Jeffry and his uncle Stan went to the store to buy groceries. They bought eggs in a styrofoam carton, four tomatoes on a styrofoam tray wrapped in plastic and disposable styrofoam coffee cups and plates for a picnic they were going to.

-4-

SAVE THE SHIELD GAME CARDS--SIDE 2

Consequence: Dry cleaners and computer companies use solvents rather than water for cleaning. Solvents emit large quantities of CFC-113 and other ozone-eating chemicals. Newer equipment has filters to prevent gas releases. CFC-113 is estimated to cause 12 percent of the depletion of the ozone.(8) Take a 1.75 inch, four-sided hole out of your shield. Next to the hole write "Solvents."

-2-

Consequence: CFC-11 is used in the manufacture of some foam insulation and accounts for approximately 26 percent of the ozone depleting chemicals. Since Alfonzo and his father chose another product, add a triangular patch with three 2.5 inch sides to your ozone shield. Label the patch "No CFC Foam."

-1-

Consequence: Although many styrofoam products are no longer made with CFCs, many are now made with HCFCs which are called "ozone-friendly" because most of the HCFC molecules deteriorate in the lower atmosphere before they reach the ozone layer. However, HCFCs still cause some ozone destruction.(6) Take a 2.25 inch square hole out of your shield. Next to the hole write "HCFCs."

-4-

Consequence: Sarah learned later that week in school that halons also destroy the ozone layer, and that the dry-chemical type of extinguisher is fine for home use. "Halons" are chemicals very similar to CFCs and account for approximately 5 percent of ozone depletion.(8) Take a 1 inch radius circular hole out of your shield. Next to the hole write "Halons."

-3-

SAVE THE SHIELD GAME CARDS--SIDE 3

Story: Billy went with his mom and dad to buy a new refrigerator because their old one quit working. He told his mom and dad that it was important that the CFCs in the old refrigerator were recycled and not let loose into the air, because they would destroy the ozone layer.

-5-

Story: A combine crew came through to harvest wheat and corn in the farm country where Megan lived. Megan's mom and dad offered the crew cold drinks in the hot afternoon. Megan overheard one of the crew complaining that his cab was hot because all the freon had escaped through a broken line in his air conditioning system.

-6-

Story: Kyla and Evan spent last Saturday helping their mom and dad plant three fast-growing shade trees on the south-west side of their house. They also replaced some old windows with new ones that would open and close, so the family could take advantage of cool morning and evening breezes.

-7-

Story: Jennifer was chosen to be a summer exchange student and went to France for the month of July. In the small town in southern France where she stayed, she saw that most of the hair sprays and household cleaning products were sold in aerosol cans. She had heard that aerosols contained compounds that destroyed the ozone, so she didn't buy any.

-8-

SAVE THE SHIELD GAME CARDS--SIDE 4

Consequence: CFC-12 used in air conditioning systems causes approximately 45 percent of the depletion of the ozone.(8) Remove a 3.5 inch diameter circle from your shield. Next to the hole write "Air Conditioning Leaks."

-6-

Consequence: Many millions of molecules of ozone- eating freon gas were not released into the atmosphere. (Freon is a word used for the types of CFCs used for refrigeration and air conditioning.) Take a inch square patch for your shield. Write "Recycling Refrigerants" on the patch.

-5-

Consequence: In Europe, CFCs are stilled used in many aerosol products, although they were banned for use in the United States in 1978 for all but "essential" aerosols. As of 1990, some CFC containing aerosols still sold in the U.S. including spray cans of plastic confetti.(8) Since Jenny didn't purchase any aerosols and because they were almost completely banned in the United States, add a 10 centimeter square patch to your shield. Label the patch "Ban CFC Aerosols."

-8-

Consequence: Shade trees and natural breezes cause homes to be cooler so less air-conditioning is needed to keep the house comfortable. The CFCs called "freon" in the air conditioner will last longer before having to be replaced. Add a 2 x 3 inch rectangular patch to your shield. Write "Nature's Cooling" on your patch.

-7-

SAVE THE SHIELD GAME CARDS--SIDE 5

Story: Garrett went with his older brother Joel to the junk yard to look for parts for an old Chevy that Joel was restoring. When they got to the junk yard, Garrett saw all the old cars, smashed up and rusting. He knew that lots of CFCs were leaking into the atmosphere from those old cars.

-9-

Story: Kara and her twin brother Kevin dreamed of being scientists. They knew that right now people don't have much choice about buying products which cause ozone depletion. We can't buy a refrigerator without CFCs or a computer that was not made with CFC solvents. They knew that someone could discover a safe substitute for CFCs. They made a pledge that if someone hadn't already found safe substitutes for CFCs by the time they grew up, that they would become scientists and work to save the ozone.

-10-

SAVE THE SHIELD GAME CARDS--SIDE 6

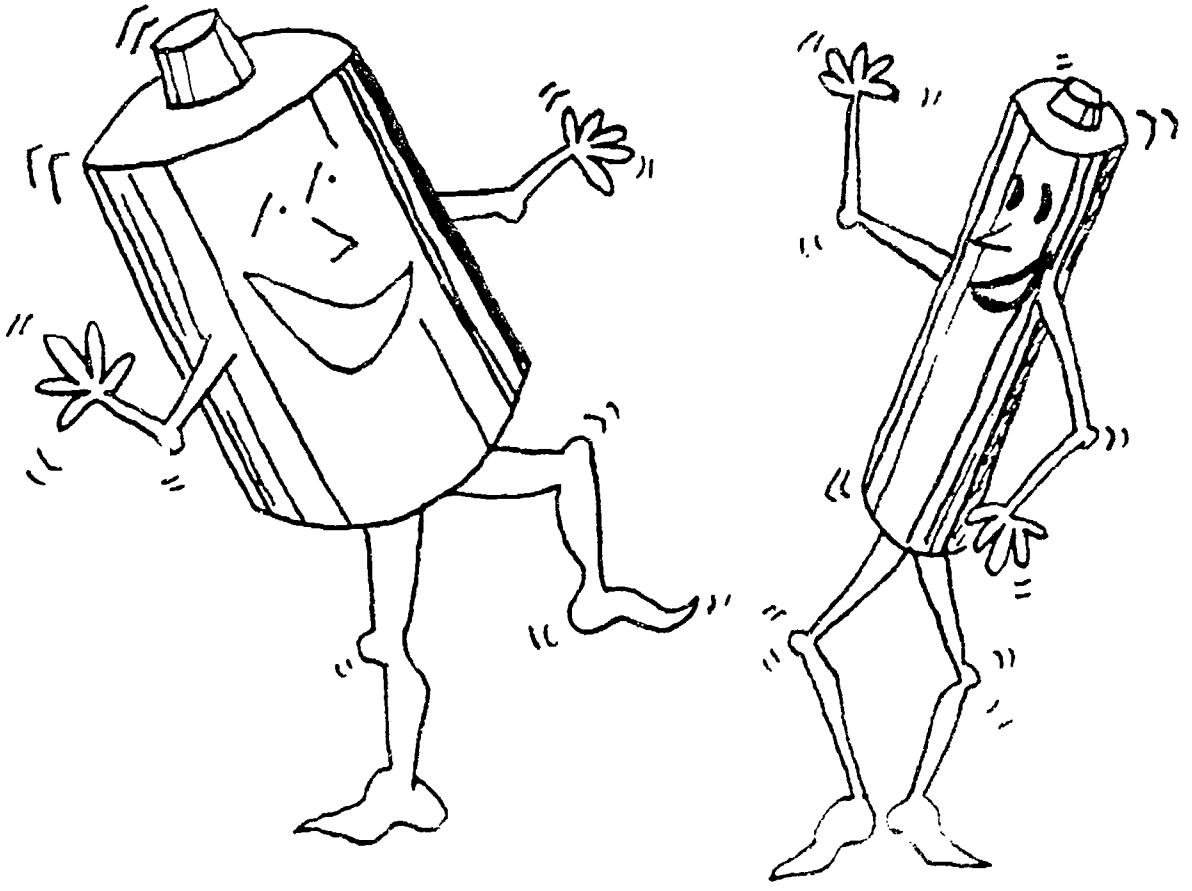
Consequence: When safe substitutes are found for ozone-eating freons, solvents, and halons, the amount of ozone depletion will slow and eventually the ozone layer will completely repair itself making life safer for future generations of plants, people and animals. Write on your shield the name of something that you want to protect by saving the ozone layer. Then write one or more ways that you will take care of the ozone layer and sign your name on the shield.

-10-

Consequence: The single largest source of CFCs emitted to the atmosphere in the United States is leaky auto air conditioners.(8) Take a 6 inch diameter hole out of your shield. Next to the hole write "Leaky Air Conditioners." Ask your dad and mom to make sure their auto air-conditioner is serviced regularly and that the CFC freon is reclaimed prior to taking any car to the junk yard.

-9-

"BATTERY BUGABOO BOOGIE"



The Life Cycle of Batteries

"BATTERY BUGABOO BOOGIE"

SUBJECTS: Science, Math, Movement Exploration, Art

GRADES: 4-6

ACADEMIC SKILLS: Analysis, classification, comparing similarities and differences, computation, discussion, group work, kinesthetic concept development, listing, media construction, psychomotor

TIME: Homework, two 30-45 minute class periods

MATERIALS: Juice, cups, cassette tape player, popular dance music tape, play money (optional), art supplies (see Battery Boogie)

VOCABULARY: Toxic, rechargeable, mercury, alkaline, nickel-cadmium, decomposition

CONCEPT: When disposed of, batteries contain toxic elements and have the potential to poison the environment. Rechargeable batteries save money, reduce waste and can be recycled by the ambitious student.

OBJECTIVE: Students will be able to explain the importance of purchasing rechargeable batteries and recycling them by participating in a survey, a classroom graphing exercise, as well as art and movement exercises. Through the movement and art exercises the students will observe how much money can be saved using rechargeable batteries and how the earth is poisoned by batteries placed in landfills. As an alternative, students will be introduced to the concept of "Kick the Throw-Away Habit."

BACKGROUND: (See attached.)

ACTIVITIES:

The following activities culminate in the kinesthetic dance exercise, "Battery Boogie", which emphasizes the need for the use of rechargeable batteries.

Battery Sleuths

Ask the students to guess how many batteries are used in their homes. Make a classroom graph of the total number. Send them home with the enclosed survey. Tell them they are battery sleuths and they are to search their home carefully for batteries of all types. The next day, make a comparative graph of the actual number of batteries they found in their homes.

Discussion

Using the background material, explain to the students that four billion consumer batteries were sold in the United States in 1992. Explain the difference between rechargeable and non-rechargeable batteries. Then explain the toxic characteristics of non-rechargeable alkaline batteries (containing mercury) and rechargeable nickel-cadmium batteries (containing cadmium). Tell them where these toxic elements come from and what can happen if they are released into the environment and ingested in the human body.

Math

1. Ask the students to name some of their favorite battery powered devices and list these items on the chalkboard. Discuss with the students the amount of money that would be saved if half of them used rechargeable batteries. For example, if the price of a new D-cell battery is $2.00 and if sixteen students recharged, there would be a total savings of $32.00.

2. Together, decide how many times the students will need to recharge their batteries in order to earn approximately $100.00. For instance, if the sixteen students recharge their batteries three times, the group can save $96.00. Discuss what the students would purchase if they had $96.00 to spend. Have the students vote to determine the most popular item. This item becomes the goal.

   Draw a scale which resembles a large thermometer with enough increments of two dollars to reach the goal. Draw a picture of the goal above it. (In our example, the scale has 48 lines to reach the $96.00 goal.)

Art Exercise

During these exercises, the students will be divided into two groups. One group will represent disposable batteries; the other, rechargeable batteries.

Ask half of the students to create symbols to represent throw-away batteries (such as a skull and cross bones.) Ask the other half to draw symbols to represent rechargeable batteries (such as pictures of the sun or of electrical outlets.) Place the symbols in a container for the students to randomly choose from later.

Classroom Setup for "Battery Boogie"

Place a "recharging table" near the thermometer scale with enough small cups of juice poured for half the class. Have enough juice so that each of the students can have approximately three to four refills of juice.

Create a "landfill corner" in an area where the students have space to do artwork. This area can be sectioned off with signs just for the day or it can literally be a "classroom landfill" where the trash the classroom generates over the course of the week is dumped, rather than having it removed by the janitor. The students will be using this corner to create representations of decomposing batteries in landfills. The following are possible options:

Option A: Provide the students with markers, crayons, paints, glue, tape, paper and an assortment of small empty boxes. With these supplies, encourage the students to create their impression of old batteries decomposing in the landfill and leaking toxins into the earth. Have them use their artwork to decorate the Landfill Corner.

Option B: Provide the students with clown make-up and body paint. Have them decorate themselves to represent the old batteries in the landfill. (Have the students stay in costume through lunch hour if appropriate.) Have two or three students explain why they look the way they do to their peers.

Option C: Provide the students with paints and old bed sheets with head holes cut through the middle. Have the students paint the sheets to represent decomposing batteries and wear them as they mingle around in the landfill.

"The Battery Boogie"

Ask the students to randomly choose a rechargeable or non-rechargeable symbol and tape it to their shirt. Explain to the students that they are to move while pantomiming batteries inside a battery operated object. For ideas they can look at the chalkboard list of favorite battery-powered devices. Turn on the dance music and encourage the students to do the "Battery Boogie." After a short period, stop the music. Tell them their batteries have "run down." Line up all the "batteries" in front of the recharging table to either be recharged (Juiced Up!) or to be sent to the landfill. If they are rechargeable, they have a drink of juice, fill in one increment on the scale and go back to the Battery Boogie where the music and dancing resumes. Start and stop the music to represent more recharges and each time give the students a drink and allow them to fill in another increment of the scale. Do this until the "goal" is reached.

If the students are playing the part of disposable batteries, send them to the Landfill Corner where they will decorate themselves or the corner to represent old batteries leaking toxins into the earth.

As the exercise comes to a close, the thermometer scale and the Landfill Corner will have been completed. Provide the landfill students with juice and bring the class together for discussion.

Discussion Ideas

1. Lead a discussion about other ways in which money can be saved through source reduction in the home. (Using cloth rags rather than paper towels to clean with, buying food in bulk, using plastic food containers rather than disposable plastic bags, etc.)

2. Discuss the various ways in which life is affected by battery toxins (air, water, ground.)

3. Discuss batteries with less toxic components.

4. Discuss the importance of recycling even rechargeable batteries when ready to discard.

5. Discuss whether or not the government should regulate the use of disposable batteries.

Variations

1. Instead of using juice, the rechargeable students could pick up play money each time they come to be recharged. At the end of the exercise have them count the money they saved individually.

2. For the art exercise, ask the students to also trace and cut out a pattern of their foot. Then write the words "Kick-The-Throw-Away-Habit" on their "paper foot." Instead of doing "The Battery Boogie," the students can dance the "Kick-The-Throw-Away Rock."

EXTENSIONS:

1. Prior to sending the "Home Battery Survey" home with the students, solicit additions to the list.

2. Have the students bring in samples of many different types of batteries (except wet-cell batteries) so the batteries can be categorized by voltage, shape, size and rechargeability. Graph the types of batteries separately to see which is the most frequently used battery in the class.

3. Discuss possible options to using batteries in the home. (plugging in appliances whenever possible, using hand powered tools, using solar powered appliances, etc.)

4. Have the students investigate both solar and electrical battery rechargers and explore the benefits of using solar rechargers.

5. For a geometry project, ask the students to recreate the shapes of various types of batteries and use these to decorate a bulletin board with the class battery graphs.

6. Discuss other disposable products which have reusable or rechargeable alternatives.

7. Service Learning Extension - Have students research battery recycling in their area and set up a battery recycling center at their school.

BACKGROUND MATERIAL:

While there are many different types of batteries available today (see chart at end of lesson), we will only trace the life cycle of toxic materials in disposable alkaline batteries and in rechargeable nickel-cadmium batteries.

An alkaline battery contains chromium, mercury and zinc, is non-rechargeable and is often used in consumer appliances. A nickel-cadmium battery, on the other hand, is a rechargeable device that contains cadmium and nickel.(1) Herein lies a very serious problem, since both the mercury and cadmium found in these batteries can have detrimental effects on people and the environment.

Mercury is a silver-colored metal found predominantly in the former Soviet Union. Some mercury is found in the United States. Most mercury comes from an ore called "cinnabar." To obtain pure mercury, refiners heat cinnabar in a flow of air. Oxygen in the air combines with sulfur in the cinnabar, forming a sulfur-dioxide gas and leaving mercury behind.(2)

Mercury is a chemical element (atomic wt. 200.59, atomic no. 80) and is used in many applications: in thermometers, barometers, paint and paper, as well as alkaline batteries. Mercury is a liquid at room temperature and flows so easily and rapidly that it is sometimes referred to as "quicksilver". While mercury is very useful, it is also very poisonous. Industries and government agencies are now trying to reduce the amount reaching the environment in any form. Mercury in the environment can contaminate plants and animals that people use for food. Scientists have discovered poisonous mercury compounds in eggs, fish, grain and meat. Mercury acts as a cumulative poison, meaning the body has difficulty eliminating mercury. As it collects in the body it can eventually cause severe illness or death. By placing mercury containing alkaline batteries into a landfill, the mercury may eventually bleed into the soil and/or ground water. Additionally, mercury is especially hazardous because it vaporizes into the atmosphere. Vaporized mercury, when precipitated into lakes can contaminate fish. Vaporization also means mercury can be inhaled directly by humans.(2)

Mercury was used in the eighteenth century in hat making. Poisonous fumes caused a disease which lead to the phrase "mad as a hatter."

Cadmium, a soft, silvery-white metallic element (atomic wt. 112.41, atomic no. 48) is no less toxic. Cadmium occurs with zinc minerals and is a by-product of zinc refining. Japan is the leading producer of cadmium. Cadmium is poisonous. People have become seriously ill or have died soon after breathing cadmium dust or fumes of cadmium oxide. Small amounts of cadmium entering the body over long periods may also damage the kidneys and deform bones. Industry and the government are currently working to eliminate any cadmium from getting into our waste streams.(2)

Batteries are big business. During 1992, in the United States alone some four billion consumer batteries were sold. Domestic use accounted for about 85 percent of the 145,000 tons of sales. The bulk of these were alkaline and nickel-cadmium batteries. The materials used in these batteries account for over 50 percent of the mercury and cadmium currently entering the municipal solid waste stream.(5)

Batteries are with us and will likely continue to be with us. Today, there is an emphasis by government on investigation and education geared to eliminate the dangerously toxic waste from discarded batteries.

As responsible citizens we can take some positive steps. The first step can be to purchase batteries with very low levels of mercury or ones with mercury substitutes. Since mercury is found primarily in non-rechargeable batteries, an even better option may be to purchase rechargeable batteries. Rechargeable batteries save money because they last much longer, and they also cut back on the number of batteries ending up in our overloaded landfills.

Rechargeable batteries are a good substitute for one-time use batteries; however, there is still the potential for toxicity to the environment once the rechargeable batteries are discarded. A simple and effective solution for this is to recycle the rechargeable battery - the cadmium will be distilled and reclaimed for use in new batteries. Currently, the only nickel-cadmium recovery facility accepting post-consumer batteries is:

Mercury Refining Co.
1218 Central Ave.
Albany, NY 12205
(1-800-833-3505).(5)

Efficient use and disposal of batteries is vitally important to ensure a healthier environment for today and for the future.

A Short History of the Battery

A battery is a device that produces an electric current by means of a chemical reaction in a terminal circuit, and consists of one or more units called electric cells. Each cell has all the chemicals and parts needed to produce an electric current. The word battery actually means a group of connected cells, even though the term is generally used to refer to single cells such as a "battery" to operate a flashlight.(1)

Batteries have been with us for a long time. The first practical battery was most likely developed by an Italian scientist named Count Alessandro Volta in the late 1790s. This battery became known as the voltaic pile because it consisted of stacked pairs of silver and zinc disks. The pairs were separated by ·· cks of cardboard moistened with a salt solution. In the 1830s, John F. Danniell an Englis· ·cmist, introduced a more efficient cell. This battery had liquid electrolytes and produce· steadier current. Then in 1859 the French physicist Gaston Plante invented the first rechargeable battery, the lead-acid storage battery. Around this same time, the non-rechargeable battery was improved upon by Georges Leclanche which led to the development of the modern dry-cell battery.

Typical consumer batteries for appliances and toys are called dry cells, while automobile-type batteries are known as wet-cells. Dry cell batteries have a jellylike or pastelike, non-spillable electrolyte chemical (the substance that conducts the electric current inside a cell). Wet-cell batteries contain liquid electrolytes.(2)

MAJOR TYPES OF CONSUMER BATTERIES:

1. **Alkaline battery**. Contains chromium, mercury and zinc. Used in consumer appliances.

2. **Lithium cell.** Contains chromium. Used in consumer photographic applications.

3. **Mercuric oxide button cell.** This battery contains the highest percentage of mercury of any battery on the market. Also contains zinc. Used in hearing aids, calculators and watches.

4. **Nickel-cadmium battery.** A rechargeable device containing cadmium and nickel. Used in consumer electronics and appliances.

5. **Silver oxide cell.** Contains mercury, silver and zinc. Used in hearing aids, calculators and watches.

6. **Zinc-air button cell.** Offered as a substitute for the mercuric oxide button cell, although this cell in not mercury free. Also contains zinc. Used in continuous operation applications, such as hearing aids and electronic pagers.

7. **Zinc-carbon cell.** Contains chromium, lead, mercury and zinc. Used in consumer electronics.(5)

GENERAL INFORMATION ON RECHARGEABLE BATTERIES:

1. Today, rechargeable batteries closely approximate the power available in disposable batteries.

2. A typical price range of size AA through size D batteries is $2.75 to $7.00 each.

3. Chargers for typical Size AA through D batteries cost around $12 to $25.

4. Depending on the brand, a rechargeable battery can be recharged 200 times. Some come with a life-time guarantee.(6)

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3. Free, John. "Electronic Newsfront: Batteries Come Clean." Popular Science. July 1992: 23.

4. Erickson, Deborah. "Cadmium Charges." Scientific American. May 1991: 122.

5. Hurd, David J. "Getting a Charge out of the Waste Stream: The Status of Consumer Battery Recovery." Resource Recycling. May 1992: 42-49.

6. John Schaeffer, ed. Real Goods. Ukiah, CA. Spring 1992.

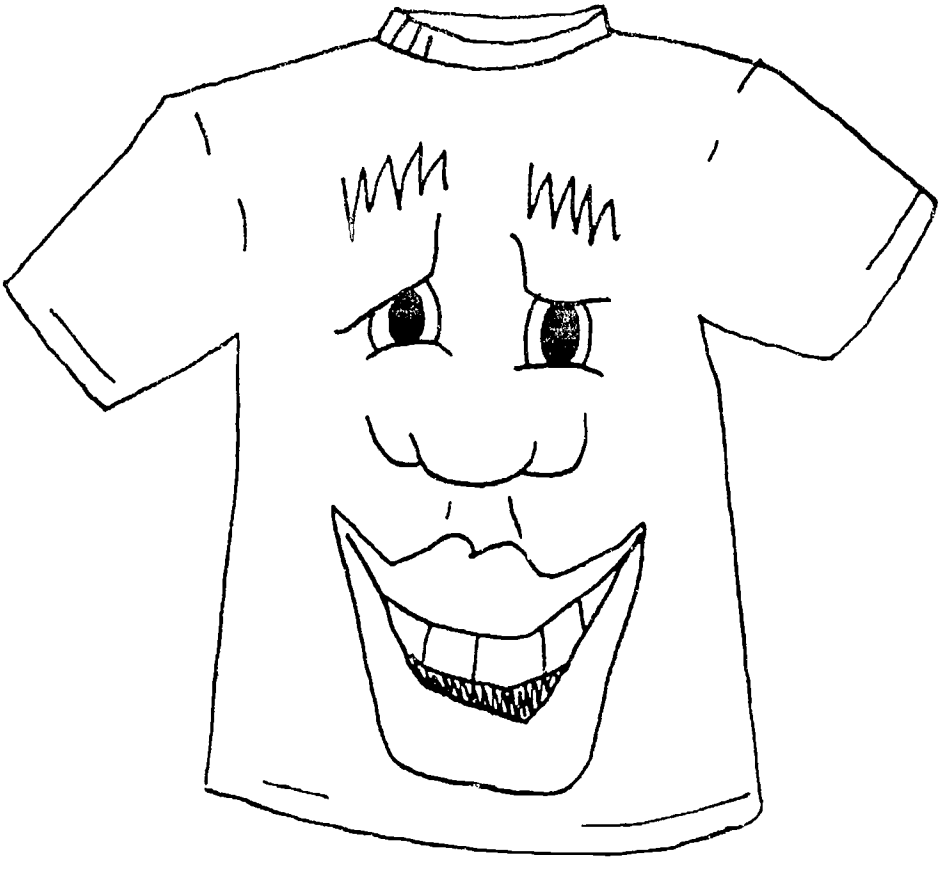
ADDITIONAL RESOURCE:

1. "Real Goods" call 1-800-762-7325 for a free catalog: source of rechargeable batteries and solar battery chargers.

HOME BATTERY SURVEY

ITEM	NUMBER	TYPE OR SIZE
Answering machines		
Automobiles		
Boom boxes/radios		
Calculators		
Cameras		
Car phones		
Clocks		
Flash apparatus		
Flashlights		
Hand Held Video Games		
Hearing aids		
Keyboards		
Lawn Mowers		
Rechargeable appliances		
Remote controls		
Smoke detectors		
Toys		
Watches		
Weed eaters		
Other		

"A T-SHIRT TALKS"



The Life Cycle of Cotton

"A T-SHIRT TALKS"

SUBJECTS: Science, Drama, Language Arts, Social Studies, Movement Exploration

GRADES: 5-6

ACADEMIC SKILLS: Application, critical thinking, discussion, evaluation, interviewing, kinesthetic concept development, psychomotor, public speaking, reading, small group work, synthesis

TIME: Two 45 minute class periods, homework

MATERIALS: Cotton ball, cotton yarn, surgical cotton, (cotton from a large vitamin jar will do), cotton fabric (borrow a bolt from a fabric store, if possible), job application forms, one for each student plus extras, 7-8 copies of the play, a beautiful cotton T-shirt, parents or another class to serve as an audience

VOCABULARY: Fibers, textiles, boll, ginning, singeing, quenching, keiring, mercerizing, immigrants

CONCEPT: Clothing is often carelessly used and discarded without a true appreciation of all the effort, time, labor and environmental costs which go into the production of cloth.

OBJECTIVE: Students will become aware of the effects of clothing consumption and be able to make better choices regarding the purchasing and disposal of their personal clothing by following the life cycle of a T-shirt.

BACKGROUND: (See attached.)

ACTIVITIES:

The following activities culminate in a play which dramatizes the life cycle of a T-shirt.

Discussion

Ask students to tell everything they know about the process which takes place to produce a cotton T-shirt. Ask them to draw a diagram depicting their ideas about where cotton T-shirts come from.

Job Applications for the Cotton Industry

Copy the pages from the play which spell-out the steps that cotton goes through from the field to the garment industry. Cut each numbered job part (excluding narration) into a separate strip and then allow students to each choose one randomly. Make enough to supply one for all the students. Tell them that this is a description of the job they are applying for in the cotton industry. Have them fill out the job application form from this lesson plan.

Choose five students to be job interviewers for the cotton industry's available job positions. These students will also be the narrators in your play, so they should have good reading skills. Each applicant must bring his/her application along with the description of the job they are applying for in the industry. They hand the strip of paper describing their job to the interviewer, along with their application. (This part of the lesson can be made more real by having interviewers sit at the head of the class and having the applicants line up to see them.)

The interviewer asks the applicant how much s/he knows about the job they are applying for. If the applicant is able to describe the job satisfactorily to the interviewer; and if the application is completely and neatly filled out, s/he is hired. If not, the applicant returns to the unemployment line to study more about their job and/or to fill out another application. Make sure the student interviewers also go through the hiring process.

Preparation for the Play

Tell the students they will dramatize their jobs in a play the following week. Their homework is to think of how they will act out their part in the process. If more than one student has the same part, have them work together on the project. Give each narrator a full copy of the play, so they can learn their parts and practice at home if necessary. Ask all the students to bring their favorite T-shirts to wear in the play.

Encourage the students to bring props and to use large physical movements and sounds ("whirr", "ping!" "chuga-chuga"), to dramatize their parts. The following game will help them do this.

Game: Cotton Manufacturing Body Mechanics

After the students have had some time to think about acting out their part in the cotton industry process, have them line up sequentially according to the part they will be playing. Then ask each student, in turn, to demonstrate his or her part. Have the group add suggestions of how to look and sound more authentic, detailed or more mechanical (where appropriate). After the students have had a little practice, the teacher will start at the beginning of the line ("harvesting"), pretending to be the cotton going through the processes. Using the various props listed in the materials section, the teacher will bounce and spin through each step, progressing down the line of students. At the end, emerge as a beautiful T-shirt!

Classroom Setup for the Play

On the day of the play, create an assembly line atmosphere where each worker will in turn act out and read his/her part. Rehearse the play; and then invite the audience to attend the performance.

In the beginning, ask a narrator to introduce the play. Have all the workers pantomime and sound out their parts. When the main narrative starts, ask the workers to stop the sounds and just pantomime their parts until it is their turn to read the description of their job. They stop, face the audience, read their part and then return silently to work. After the last narrative, the workers all make their sounds and pantomime for a few minutes and then freeze in motion. This signals the end of the play.

"A T-SHIRT TALKS"

A play about the life of a T-shirt

Narrator #1

This is a play about the life of your favorite cotton T-shirt. Clothing is often used carelessly and thrown out without understanding all the effort, time and labor which go into the production of cloth. There are also some environmental damages caused by cloth production.

Cotton is the single most important fiber. *(Hold up some surgical cotton to illustrate the fibrous nature of cotton.)* Cotton is grown in the United States and throughout the world and accounts for nearly half of all the fiber used to make cloth. The annual U.S. production of cotton cloth is more than 56 square yards per person.(1)

Narrator #2

The cotton plant grows 3 to 6 feet tall in a shape similar to a pyramid. The leaves of the cotton plant are somewhat like those of a maple tree. The development of the soft, fuzzy fiber begins with a flower. After about one day the flower fades and a capsule forms in the base of the flower which is called a "boll". This "boll" contains seeds and the soft, fuzzy, white fibers which are spun into cloth.(2)

Narrator #3

Traditional cotton is grown using a tremendous amount of pesticides. Pesticides are used because cotton is susceptible to various diseases and insect pests, including the boll weevil.(1) In addition, most cloth dyeing requires harmful chemicals and creates toxic waste. Dying cotton uses up to 85 percent of the energy needed in cotton processing.(3)

Narrator #4

Naturally colored "wild cottons" were discovered in 1982 by Sally Fox. Wild cottons grew in a range of colors, but were unusable for machine spinning because the fibers were too weak. By cross breeding with commercial cottons, fiber strength was increased to meet current manufacturing standards. Brown, green and pink natural cottons were introduced to the market under the name "FoxFibre Colorganic" in 1993. Bronze, orange, teal and yellow are expected to be marketed in the coming years. Unlike regularly dyed cottons, natural cotton colors get brighter when washed.(3)

Narrator #5

Now organically grown, naturally colored cottons are marketed by Levi Strauss & Co under the name "Naturals", L.L. Bean, Esprit and Seventh Generation. Still, naturally colored organic cotton only accounts for a fraction of the total world production of cotton. In addition, these natural fabrics will likely remain more expensive than traditionally produced cotton clothes, for the near future.(1)

This play, *"A T-Shirt Talks,"* is about cotton going through processing, from harvesting to the factory, to finally becoming a T-Shirt. You'll be amazed at how much work it is! We hope you enjoy the play.

Job #1 Harvesting. Once done by slave labor, harvesting cotton is now done by machines in the United States.(1)

Job #2 Cleaning. Dirt, sticks, leaves and other foreign matter is removed with a special machine.(1)

Job #3 Ginning. Fiber is separated from the seeds. This work used to be done by slave women who scratched the seeds out with their fingernails. It was very slow and very hard work. Now industry uses the "Cotton Gin" which was developed by Eli Whitney.(1)

Job #4 Baling. Cotton is tightly packed into bales and wrapped with paper and metal bands. These bales weigh about 500 pounds. The cotton is then sold to a mill.(1)

Narrator #1

Changing a bale of raw cotton, with its millions of fibers, into cotton fabric requires a series of complicated manufacturing operations. The first step is the production of yarn, which is woven or knitted into cloth. The cloth is dyed, finished and shipped to a garment maker, where the material is cut and sewn into T-shirts or other items.

Job #5 Cleaning. The metal bands and wrappings from around the bale are removed and the cotton is cleaned again. The cotton goes to a "picker" which forms the loose, fluffy fibers into a sheet which looks like a giant roll of surgical cotton.(1)

Job #6 Carding. The cotton is pulled apart by a cylinder covered with fine wires. Then the machine presses the fibers together into a thin web.(1)

Job #7 Drawing and Combing. "Drawing and Combing" is like combing your hair with a lot of hair falling out. This process lines up the fibers in a straight line and removes the short fibers of cotton. As much as 20 to 25 percent of the fibers may be removed as waste during the combing operation.(1)

Job #8 Roving and Spinning. "Roving" winds the straightened cotton "web" onto a spool. At the same time the fiber is twisted, or spun, to make yarn.(1)

Job #9 Knitting and Weaving. This is where the yarn is knitted, or woven into cloth. Weaving is interlacing fibers at right angles to each other.(1)

Narrator #2

DYEING AND FINISHING

After it is woven or knitted, the fabric is inspected for defects and prepared for dyeing and finishing. This process consists of singeing, kiering, bleaching, drying and sometimes mercerizing.(1)

Job #10 Singeing. In this process the cloth is rapidly drawn over hot plates or through gas flames at a temperature of about 1500 degrees fahrenheit. The cloth is then dunked in a quenching bath to prevent it from burning. This removes lint and loose threads from the cloth.(1)

Job #11 Kiering and Bleaching. To complete the removal of specks of hulls and seeds, the cloth is boiled in a special solution in big pressure cookers, called kiers. If the fabric is to be white or to be decorated, it is bleached.(1)

Job #12 Mercerizing. If desired, the cloth may be treated with caustic soda in a process known as mercerizing. This adds strength and shine to the fabric and makes the cloth more absorbent and easier to dye and finish. Mercerized cottons are used in shirts and dress socks.(1)

Job #13 Dyeing. Although color may be applied to raw cotton or to the spun yarns, it is usually applied to the fabric after it is woven.(1)

Job #14 Finishing. Chemicals may be added for flame resistance and water repellency.(1)

Narrator #3

THE GARMENT INDUSTRY: THE PROBLEM WITH SWEAT SHOPS

Once the cloth is finished, it goes to the garment industry where T-shirts and other clothes are stitched together. Although many clothes are sewn in modern, safe factories, many others are produced in "sweat shops." Generally speaking, "sweat shops" are businesses which violate labor laws or health and safety codes.(5)

Narrator #4

Most sweatshops today, as a century ago, are in the garment trade. Competition from foreign countries, where wages are much lower than in the United States, has made it very important for U.S. factories to slash costs. About 3,000 of the 7,000 clothing factories in New York are sweatshops. These companies employ about 50,000 workers. At least one quarter of the garment workers in California work in sweatshops, according to the International Ladies Garment Workers Union.(5)

Narrator #5

Often there are fire dangers in sweat shops. In the airless spaces of some sweat shops, cancer causing chemicals which are used to treat fabrics can build up to dangerous levels. Some owners hide an illegal shop behind a legal one; and others keep two sets of books to avoid paying overtime. Sometimes owners pay illegally low wages and don't pay overtime or provide any benefits.(5)

Sweatshops continue to exist because many new immigrants, who are short on skills and desperate for jobs, won't complain or go to the authorities.(5)

Narrator #1

As you can see, our ordinary cotton T-shirts have a big story behind them. Lots of pesticides are used on most cotton; and a lot of work goes into making cloth. Finally, some clothes are put together by people who have to work in sweatshops.

Cotton appears everywhere in the home. It is woven into rugs, carpets, drapes, curtains, slipcovers for furniture, towels and bedding. Half of the entire annual cotton crop is made into clothing for men, women and children.(1)

Teacher (or chosen student)

Go through the line, as in the rehearsed game: "Cotton Manufacturing Body Mechanics". Using the props start from a cotton ball and end as a beautiful T-shirt.

Narrator #2

We hope you have enjoyed our play, "A T-Shirt Talks." Thank you.

Discussion Questions:

1. Ask the students what surprised them the most about the production of a cotton T-shirt.

2. Ask the students about some other ways of getting rid of old clothing besides throwing it away. (Quilts, hand-me-downs, rags in the kitchen - rather than paper towels, thrift stores donations.) *(See background material for additional ideas)*

3. Discuss with the students the best way to donate clothes to a thrift store. (Donate *clean* clothes in season so they'll be available when they are most needed. Don't use thrift stores as a "garbage dump." Goodwill Industries has an annual garbage bill well over $1 million. They could use that money to provide services to the needy rather than paying garbage fees.(6))

4. Ask the students if they will think about clothes differently because of this lesson.

EXTENSIONS:

1. Invite a local weaver, or quilter to do a class demonstration.

2. Calculate the number of people involved in the creation of one T-shirt.

3. Create a relief map emphasizing the cotton belt in the U.S.

4. Have each student personalize a T-shirt with an environmental theme.

5. Sponsor a "clothing swap" where students bring in out-grown clothing to give to younger classes.

6. Make a quilt from used clothing.

BACKGROUND INFORMATION:

A Short History of Cotton

Archaeologists have found records from buried Indian cities in the Indus Valley that shows cotton was grown and woven as early as 3,000 B.C. Mummies wrapped in cotton have been found in places like the Inca tombs of Peru and the Nile Valley of Egypt. Egypt produced very fine woven linens as far back as 2500 B.C.(2) There is also some evidence to indicate that cotton fabrics were produced in ancient Mexico as early as 5700 B.C.(1)

Around 500 B.C., the Romans started wearing woven gowns made out of the cotton plant imported from the Mediterranean. During the Middle Ages, the Germans excelled in weaving fine cotton cloth and exported it to France and England.

Raw cotton became known in England during the late 13th century. At first it was used, not for clothing, but for making candlesticks. In the early 18th century, England made very large quantities of fustian (a cloth made of cotton and linen). The woolen weavers protested the high sales of fustian and persuaded Parliament to pass laws that made it illegal to sell cotton cloth in England. This law was not repealed for 36 years. Even so, within 25 years, there were 30,000 cottage hand weavers producing cotton material in England.

In South America, the Indians were weaving beautiful vests, ponchos, loincloths, draperies and blankets from wild cotton or from the hair of the llama, alpaca and vicuna, all animals inhabiting the Andes' rocky valleys.

During Colonial times, cotton was grown in the Southern colonies and shipped to England. The British tried very hard to discourage Americans from starting their own mills by forbidding English-trained weavers to emigrate to America and by making it illegal to export any spinning or weaving machinery.

In the late 18th century an English weaver, Samuel Slater, smuggled himself out of England and came to New England. He built the first successful American cotton mill, at Pawtucket, Rhode Island, in 1790. He also succeeded in building the first water-powered spinning and weaving factory in the New World.

A major problem with the American-type cotton plant was that the fiber clung harshly to the seeds and this made it very hard to separate. Negro slaves were ordered to remove the seeds by hand, producing about a pound of cotton a day. This process was hard work, time consuming and resulted in very high fabric prices.

Eli Whitney, tutor of a son of a South Carolina planter, witnessed Negro slave women scratching the seeds from the raw cotton with their fingernails. After viewing this very difficult labor, he decided to build a machine to automate this operation. Eventually, Whitney developed a machine with a toothed roller which held the cotton fibers while dropping the seeds through gratings. Another roller, moving in the opposite direction of the first, removed the cotton from the first cylinder. Whitney called his invention the "cotton gin" which was short for engine. It made quite a difference. In 1793, 487,000 pounds of cotton were picked by hand and exported. By 1811, when the gin was in use, over 62,000,000 pounds were exported.

Today, in America, the "cotton belt" stretches about 3,000 miles in the southern United States, from Georgia to California. This is the greatest cotton producing area in the world. "American Upland" cotton is cultivated in many cotton producing countries around the world and accounts for 85 to 90 percent of the world's total cotton production.(1)

Reusing and Recycling Old Clothes

Old clothes and home textiles can be reused. By donating them to nonprofit organizations like Goodwill Industries or the Salvation Army, clothing is provided for disaster victims and the homeless. These nonprofit agencies also redistribute clothing into your community through thrift stores. Second-hand clothes are also important to people in Third World countries. In 1988, for example, 23 million pounds of used textiles went to Pakistan alone.(5)

Recycling or reusing clothes saves resources. About half the clothes Americans wear are made of synthetic fibers produced from oil, a non-renewable resource. The rest are made of natural fibers, often produced with pesticides, chemical fertilizers, etc. Reusing clothes saves landfill space, too. In Washington D.C., for example, 2 million pounds of clothes are kept out of landfills every year by the Salvation Army alone.(5)

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A T-SHIRT TALKS

APPLICATION FOR EMPLOYMENT FOR THE COTTON PRODUCTION INDUSTRY

PERSONAL INFORMATION Phone # : _____ Date: _____

Name: _____ Social Security Number: _____
last first middle initial

Address: _____
street city state zip

EMPLOYMENT DESIRED

Position: _____ Date you can start: _____

Are you employed now?: _____ If so may we inquire of your present employer? _____

EDUCATION	Name and location of school	# of Yrs attended	Subjects Studied
Grammer School			

EMPLOYER (list below last employer or present employer)

Date Month/Yr.	NAME AND ADDRESS OF EMPLOYER	SALARY	POSITION	REASON FOR LEAVING
From:				
To:				

Special Skills: _____

Activities: (civic athletic, etc.) _____

REFERENCES: Give the name of a person not related to you, whom you have known at least one year.

Name	Address	Business	# of Yrs

I certify that all the information submitted by me on this application is true and correct.

_____ Date _____ Signature

DO NOT WRITE BELOW THIS LINE

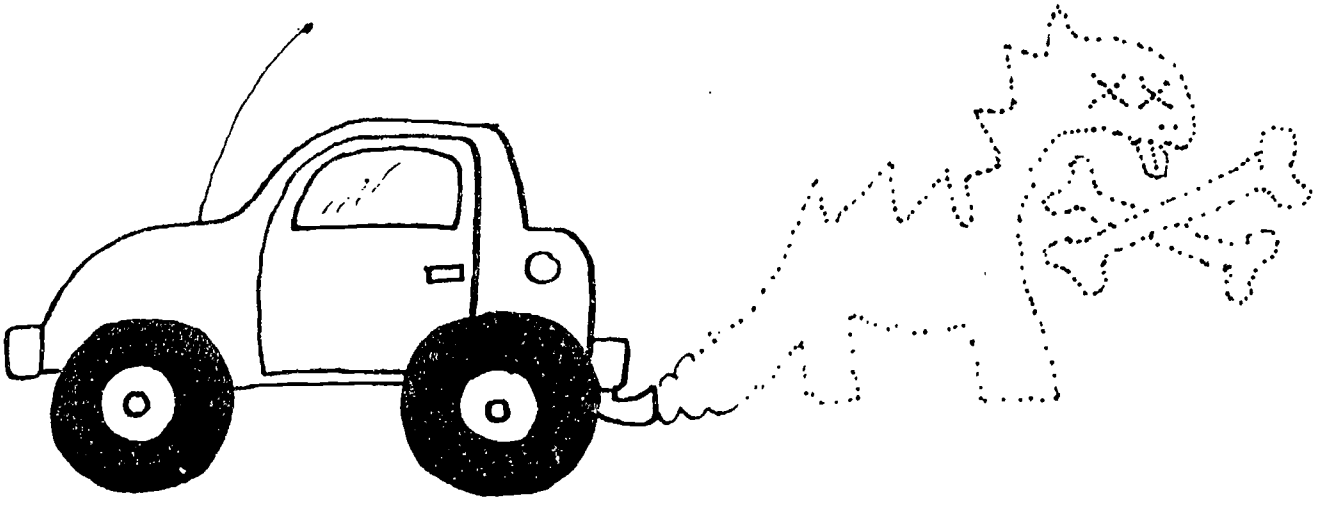
Remarks: _____ DATE: _____

Neatness: _____ Hired: _____ Yes _____ No Position: _____

APPROVED: _____
EMPLOYMENT MANAGER

"IT'S NOT REALLY HORSEPOWER ANYMORE"

There's A Dinosaur Driving Down The Street



The Life Cycle of Gasoline

"IT'S NOT REALLY HORSEPOWER ANYMORE"

-or-

"There's a Dinosaur Driving Down the Street"

SUBJECTS:	Science, Math, Social Studies, Art, Movement Exploration, Language Arts
GRADES:	5-6
ACADEMIC SKILLS:	Analysis, application, computation, cooperative learning, critical thinking, discussion, evaluation, kinesthetic concept development, observation, problem solving, psychomotor, research, speaking, synthesis, visualization
TIME:	Three to four 45 minute class periods (Note: The last activities are outdoor activities.)
MATERIALS:	A variety of mask making "trash," (see mask-making exercise) tape and/or glue, string or yarn, paper punch, a map of your community, articles from a local newspaper on regional air pollution, magazine photos of oil rigs on fire, oil spills in the ocean, smog, etc. "Keys" for Smog's Treasure (see exercise), a good tire gauge
VOCABULARY:	Fossil fuel, non-renewable, by-product, exhaust, refinery, air quality
CONCEPT:	As a nation, we constitute 5 percent of the world's population, but consume over 25 percent of the world's energy.(4) Motor vehicles, a major source of air pollution, consume over 60 percent of the petroleum used in the U.S.(5) Cars offer freedom and mobility, however their ever-increasing use is a major cause of acid rain, smog, noise and climatic threats. Clean substitutes for these polluting, non-renewable fuels must be found for future generations.(6)
OBJECTIVE:	The students will be able to explain the life cycle of gasoline and the effects of its consumption on their lives, their community and the world. They will learn ways they can reduce their dependence on the automobile and create a vision for pollution free transportation in the future.
BACKGROUND:	(See attached.)

ACTIVITIES:

Discussion

1. **What is a Fossil Fuel?**

   Open a discussion regarding fossil fuels by asking the students, "Why do you think gasoline is called a "fossil fuel?"

   Have students write a short paragraph or sentence of their ideas. List these possibilities on the board. Choose a student with good reading skills to read the first paragraph in the background information, which explains the origin of the term. Then ask: "Were your ideas close?"

2. **The Life Cycle of Gasoline: From Fossils to Foul Air**

At this point you can choose how you would like the students to explore the continuing life cycle of automobile gasoline. Some ideas might be:

1.) Discuss and outline their ideas about the life cycle of gasoline. Then on the chalkboard, outline the life cycle of gasoline using the information from the attached background materials. Discuss the environmental consequences of each stage of the life cycle.

2.) List the steps in the life cycle of gasoline (formation of oil, detection of oil, drilling and extraction, transportation, refining, automobile use, exhaust). Divide the students into small groups to research those areas, including the associated environmental impacts of each phase of the cycle.

3.) Visit a local refinery.

4.) Have a speaker come in to discuss the life cycle of gasoline. Possible speakers include: A government official working with air quality; a person from an environmental action group; a business leader in the petroleum industry; or a parent that works in the industry.

Discussion

Ask the students why fossil fuels are important to us. Let the students discuss this topic until there is a "lead in" for the following activity.

Math

1. In this activity, students will create a chart illustrating the average number of miles driven in the "classroom car" in a single day. Using a local map, have students estimate the miles travelled in a car per day. (optional) Extend this exercise for one week. Total the entire classroom mileage and determine a daily average.

Discussion: Conserving on "Classroom Car" Miles

Utilizing the information in the background material entitled "America's Love Affair With the Automobile," discuss ways to reduce gasoline use. Some strategies may include:

1. Using the map of the community, make a list of destinations, including errands: after school classes or events, grocery stores, malls, etc. Have students write down a schedule which reduces the number of miles they travel by combining errands and carpooling when possible.

2. Identify alternative means of travel including walking, bicycling, mass transit, etc. and utilize these to reduce mileage. (See the extension about improving people mileage to vehicle mileage ratios.)

Art Activities

Mask Making: "Put on Your Gas Face"

Students will make masks created with "trash". Have students bring paper sacks, paper plates, tubes from hand towels and toilet paper rolls, different varieties of paper, pieces of metal such as springs, screws, nuts and bolts, aluminum foil, etc. Trash can be collected from a variety of sources including the school kitchen, school offices, art rooms, custodians closet or other interesting places.

Using paper plates or bags as the foundation, each student will create their own design representing the various stages of the gasoline life cycle including dinosaurs, drilling rigs, ship tankers, trucks, pipe lines, refineries, automobiles, exhaust pipes of vehicles or gas masks. The only constant for the masks will be a cardboard tube breathing apparatus on each student's mask. (These masks will be used in several of the following activities.)

To finish, punch holes in each side and attach the string or yarn to the masks.

Graphic Design: "WARNING!"

Have students design warning signs which illustrate the associated hazards of exposure to gasoline and its by-products at various phases of its life cycle. Write an example of a warning sign on the board. ("Warning: Intentional Inhalation of Combustible Dinosaur Remains Has Been Proven to Result in Severe Pulmonary Distress and Death.") After a short discussion about warning signs, have each student design their own. At the conclusion of this lesson, decorate the classroom or hallway with the completed masks and signs.

Physical Action/Cooperative Game: "Smog's Treasures"

This game is an adaptation of "Smaug's Jewel's" taken from The New Games Book. It is a rough and tumble game that includes running, tagging, sliding and possibly falling. A large, soft surface such as a very large gym mat, or a grassy area outside is required. If there are concerns regarding the set up and implementation of a game of this activity level, the physical education specialist may have some valuable input.

Smog's Treasures is designed to reinforce the value of group cooperation. (Finding solutions to global problems such as air pollution will require cooperation among all sectors of society.) Discuss with the students situations in which a group can be more successful than a single person.

It is important for the students to understand that this is a cooperative game and not "every man for himself"! Students will discover that they must strategize together to catch Smog unaware.

The game includes a central character, Smog the Dragon, and all of his worthy opponents (the rest of the class). Smog will stand guard over a pile of "keys" in the center of a ring of students. Students will have to work cooperatively to outwit him/her and steal the keys to the treasure. The treasure trove consists of all the students' masks placed on a table safely away from the action. The "keys" - one per student - can be any items that remind students of the gasoline life cycle. These could be empty plastic oil containers, pieces of black rubber gas line, toy cars or trucks, or other small items. A pile of handkerchiefs can also be an effective and soft set of "keys".

The Rules of the Game

1. All the students must surrender their masks and place these treasures safely on a table in the corner. Tell the students that the treasure table is guarded by an invisible door with many key locks. The door can only be opened when all the keys are present. Students must work together to make certain that everyone has a key. Together they can open the door to the treasure table.

2. Choose one person to be Smog the MIGHTY Dragon who stands guard over his/her treasures. (The teacher is often a good choice for the first round.) Everyone else forms a wide circle around Smog and tries to steal the keys to the treasure without being tagged by Smog. (A good roar with some fancy footwork on the part of the dragon makes the game fun.)

3. Smog the MIGHTY can range as far from his/her keys as s/he dares. Smog's power is in his touch. If a student gets touched by Smog s/he is frozen in place until the end of the game, or until s/he is rescued by a classmate.

4. Other students can rescue their frozen classmates by handing them a key.

The usual amount of time for a dragon to last is from 30 seconds to a few minutes. However, occasionally a dragon has been known to freeze all the participants and unmercifully walk away with the treasure!

Teaching Strategies During the Game

The teacher can call groups of students into a huddle far from the dragon's ears and help them with cooperative strategies. Some common strategies are: students all charge Smog at once (some sacrifice themselves, later to be unfrozen by a rescuer); some students distract Smog while one sneaks up and steals the keys by reaching between his/her legs; or a few students pretend to be frozen and then lunge for the keys when Smog is distracted.

Nosy Super Sleuths Field Trip

After a couple rounds of the game, have students put on their masks and go on a walking field trip in the neighborhood of the school to see if they can "sniff" out gasoline based pollution. Events can be staged, such as arranging for a school bus to be running outside the school. Students can wear their masks like gas masks for the journey, or pretend their masks help them locate sources of pollution.

Take along a good gas gauge and check the air pressure in the tires of one or more cars. Compare the pressure found to the maximum p.s.i. (pounds per square inch) listed on the side wall of the tire. (It's a good idea to get permission from the car owners first.)

It may be best for the teacher to demonstrate checking the air pressure, since lots of air pressure can be lost during this process, if done improperly. Keep in mind that tire air pressure varies during the day according to heat. (Tires should not be inflated to their maximum p.s.i. on a cold morning and then driven on the highway on a hot afternoon. This could result in over-inflation.) Reiterate to the students that an estimated 100,000 barrels of oil could be saved per day, if Americans kept their tires properly inflated!

Visualizing the Future

(**Note to the Teacher:** Once the problem has been graphically defined, it is important to overcome any feelings of hopelessness and fear which often come up. These fears create obstacles to creative problem solving. Visualization is one method to remove these obstacles and to empower students to believe in and achieve a better future.)

Before returning to the classroom, ask the students to sit in a circle and visualize the world of their future in 5, 10, or 20 years--a world without pollution caused by burning fossil fuels. Ask them to close their eyes for a moment and see, hear and feel themselves as the scientists, inventors, designers, engineers and teachers of the future, designing pollution-free transportation for everyone. Have them visualize the car they would like to drive when they are their parents' age and have children the same age as themselves. What will it look like, and what fuel will it use? Then ask them to open their eyes and share and brainstorm their ideas. Remind them that the funnier and crazier the ideas, the better. (One 6th grader suggested a voice activated electric skateboard!)

EXTENSIONS:

1. Have the students calculate the ratio of the number of people miles driven compared to actual miles driven. People miles are determined by how many passengers are in a car at one time. (One person in the car multiplied by four miles driven results in 4 vehicle miles and 4 people miles. Five people in the car multiplied by four miles equals 4 vehicle miles and 20 people miles.) Have the students chart their people miles for a minimum of one week and determine a daily average.

2. Have the students calculate the number of miles and the amount of air pollution created by an average car full of teenagers out on a Friday or Saturday night "cruisin."

3. Have the students research and present reports on non-gasoline powered automobiles. These could include electric (grid-powered), solar, hydrogen, ethanol, or natural gas powered vehicles.

4. Have students draw pictures of the pollution-free cars of the future.

BACKGROUND INFORMATION:

(**Note to the teacher:** The first part of this background information is similar to the background for the lesson regarding plastics: "**How to Dress a Dinosaur: From Oil to Yogurt to...?**" Gasoline and plastics are both petroleum derived products.)

Geologic History of Fossil Fuels

Why are petroleum fuels called "Fossil Fuels?" The current theory is that petroleum came from plants and animals, especially plankton, which lived in shallow seas millions of years ago when dinosaurs roamed the earth. The remains, traces and impressions of these creatures are preserved in the earth's crust and are called fossils. Oil and gas are thought to be some of these remains and therefore are called fossil fuels.

The theory is that oil and natural gas were formed as millions of aquatic plants and animals died, decayed and slowly drifted to the bottom of the shallow seas. Here they were covered up by layers of sand, water, rock and mud. Besides layering due to wind, major changes occurred in the earth's crust over the last few hundred million years due to natural events such as floods, volcanic eruptions, landslides and earthquakes. Sometimes oceans covered vast areas which are now dry land and vice versa. The decaying plants and animals were compressed by the weight of all the layers which formed on top of them. This pressure created extreme amounts of heat. Because of the heat and pressure, as well as some bacterial action, chemical changes caused the remains of these creatures to turn into crude oil and gas.

Once oil and gas were formed, they moved through layers of porous rocks until reaching non-porous layers. There they accumulated in "traps" or pockets. The gas collected in the tops of the pockets and the crude oil settled to the bottoms of these natural "traps".

Modern Use

Geologists use sound waves to detect oil traps. Drilling rigs tap into these traps and usually pump out the gas first. Then the oil is removed and transported to refineries.

During transportation of the oil, sometimes accidents occur and oil spills result. After a shoreline spill, it can take decades for the environment to recover. Large animals and birds get coated with oil and are killed, or eat the oil and die from poisoning. Some of the oil dissolves in the water and is absorbed into the tissue of plants and animals. From there it is passed along in the food chain, even up to humans who eat fish or shellfish. Compounds in the oil can cause cancer or mutations in various life forms. Although commercial oil spills are serious, more oil than the Exxon Valdez oil spill is dumped on the ground or down storm drains by people who change their own automobile oil *every two weeks!* (8)

When oil does safely reach the refinery, this "petrochemical soup", which is called crude oil, is processed by chemical weight into different products.

Some of the products produced are: gasoline, solvents, jet fuel, kerosene, heating and diesel fuel, industrial oils, waxes, lubricating oils, greases and petroleum coke. These products can be further refined into plastics, pesticides, fertilizers, synthetic fabrics, acids, cleaning fluids and asphalt.(1)

Environmental Concerns

Oil is the main energy resource for the industrialized world, and the reserves of this resource are limited. A consequence of using this energy source is the pollution it causes. When engines burn gasoline or other petroleum fuels, they release toxic gases and other waste products into the air. These substances can cause respiratory diseases, cancer and other health problems. They also contribute to acid rain and may affect global climate change.(2)

Alternative power sources, such as sunlight, electricity, ethanol and methane, can reduce or eliminate many of the pollution problems associated with burning fossil fuels.(2)

America's Love Affair With The Automobile

In 1993, U.S. drivers will burn three billion barrels of oil while making the equivalent of 12,000 round trips to the sun. Americans own 135 million automobiles, which consume over half of the oil products used in the United States. In fact, two percent of the land surface of the U.S.--an area the size of Georgia--has been paved over for roads and parking lots! While more environmentally friendly and renewable fuels for transportation are still being developed, there are ways to use fossil fuel burning cars with respect, keeping in mind the environmental damage they cause.

DRIVING FOR A GREENER PLANET(3)

1. Drive conservatively. Live close to your work and schools. Carpool. Use public transportation. Ride your bike. Walk.

2. Keep tire pressure up. The U.S. Department of Energy projects that 100,000 barrels of oil a day could be saved if Americans kept their tires properly inflated.

3. Keep the engine tuned up. Minor tune-ups can improve mileage by 10 to 15 percent. Two misfiring spark plugs will reduce mileage by 20 percent.

4. Select the best mileage car available in the size needed. The lowest-mileage mid-size car can save up to $500 in fuel costs the first year.

5. Plan trips. Ride share to work, as well as social and recreational trips. Combine family errands. Shop by phone and mail.

6. Don't use air conditioning unnecessarily. Park in shaded areas. Don't idle the engine for more than 30 seconds. The maximum economy for most cars is obtained when it is driven between 35 and 55 miles per hour.

Cars of the Future

Under California's South Coast Air Quality Management District Plan, 2 percent of the cars sold in 1998 would have to have "zero emissions," rising to 10 percent zero emission cars by 2003. This was done largely because air pollution in the Los Angeles basin is estimated to cost the region $9 billion annually in health costs.

This plan has sparked innovative thinking in automobile design. Light-electric vehicles (LEVs)--two-passenger, battery-powered city cars with a range of 50 to 80 kilometers and a top speed of 50-100 kilometers per hour--are now on the road. In Switzerland, due to tax incentives, electric cars sell for less than an average small car.

In the United States, the LEV market got rolling in 1990, when General Motors announced its experimental sports car, the Impact. Fifty Impacts are to be tested on the road in 1993, and the car should be available for general distribution by the late 1990s.

Much of the effort to develop electric vehicles is focused on better batteries. Today's lead-acid batteries have many disadvantages. They are heavy and expensive, must be recharged frequently and don't have the same long life as the vehicle. In 1991, the U.S. Department of Energy invested $260 million to develop high-energy-density, long-lived batteries that can be mass-produced for standard automobiles.

During the transition from gas-powered to electric cars, natural gas will undoubtedly play a major role, along with improved auto efficiency design.

Some of the most promising fossil fuel automobile technology involves creating

hybrid vehicles. In hybrid cars, the car's engine is used to generate electricity, which drives an electric motor connected to the wheels. This allows much greater efficiency than the standard motor which looses 80 percent of its energy in waste heat.

If the entire U.S. auto fleet were converted to lightweight, natural gas-powered hybrids, only a 20 percent increase in U.S. natural gas supplies would be needed to fuel it, and oil imports could be eliminated. Natural gas fueled cars would have carbon dioxide emissions 85 percent lower than today's automobiles and carbon monoxide and nitrogen oxides would be reduced even more.(7)

Eventually ways may be found to run all cars on renewable hydrogen or from solar power. The sun is our greatest energy resource. Two days of solar radiation falling on the earth equals the world's total fossil-fuel reserves.(4)

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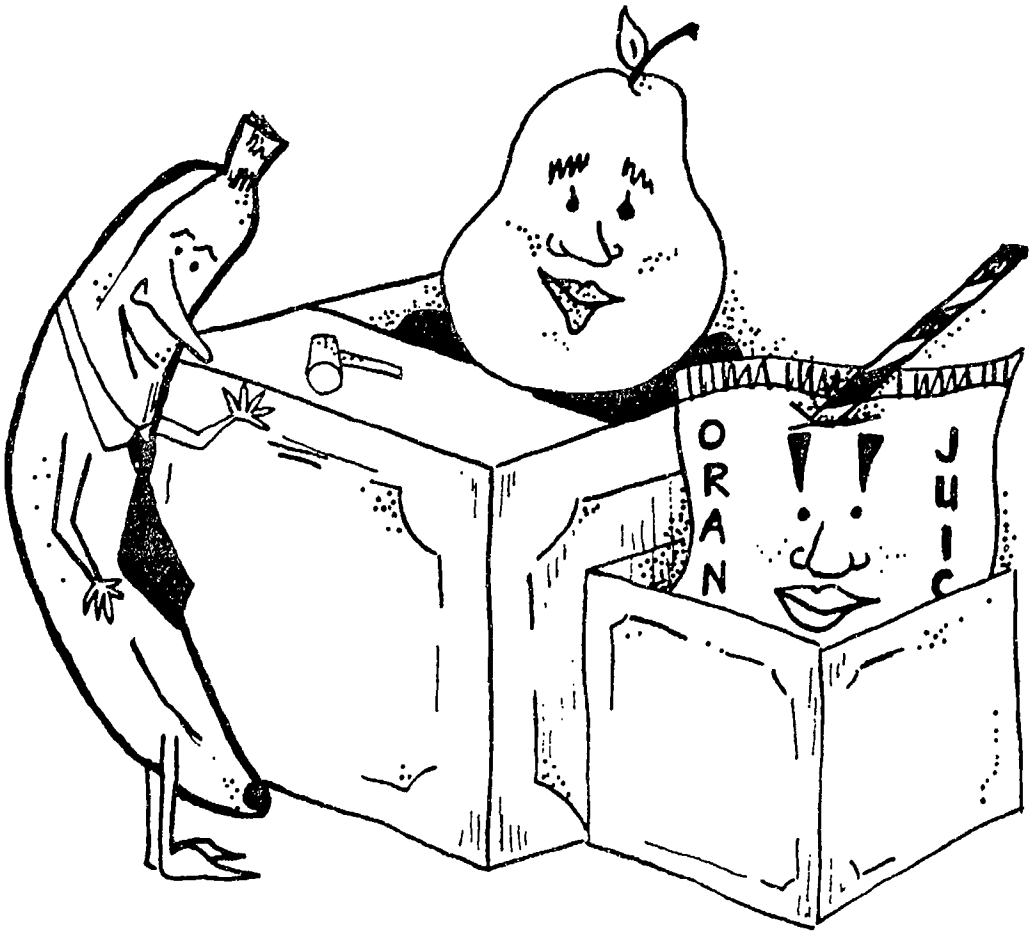
2. Fluegelman, Andrew. The New Games Book. New York: Doubleday: 1976.

3. National Renewable Energy Laboratories, 1617 Cole Blvd., Golden, CO 80401 (303) 231-1000. (NREL sponsors SUNRAYCE and the Junior Solar Sprint races.)

"A JUICY CASE"

Aseptic Packaging v. Environmentalists



The Life Cycle of Aseptic Packaging

"A JUICY CASE"

Aseptic Packaging v. The Environmentalists

SUBJECTS: Social Studies, Language Arts, Drama, Technology Education

GRADES: 5-8

ACADEMIC SKILLS: Analysis, application, cooperative learning, critical thinking, evaluation, interviewing, public speaking, reporting, research, small group work, writing application

TIME: **This activity will take place over a 4-6 week time period.**

Research Time - Research time requirements will vary depending on the specific method of inquiry employed. If material is ordered by mail or phone, allow at least three weeks.
Presentation Time - Five to ten minutes is suggested for each group to present their information to the class.
Trial Preparation Time - Students will prepare information, based on their role in the actual trial. Allow at least one week.
Trial Time - One or two class periods of 30-45 minutes each depending on the level of involvement. There should be adequate class time allowed for the attorneys to formulate their closing arguments and for the jury to make their final deliberations.

MATERIALS: "Courtroom Procedures" handouts, video of dramatic courtroom scene

VOCABULARY: Aseptic packaging, hydrapulping, polyethylene, prosecutor, defendant, plaintiff, testimony, evidence, libel, civil case, criminal case, direct examination, cross examination, impartial

CONCEPT: Aseptic packaging constituted .18 percent of all containers in 1985 and is predicted to rise to more than 15 percent by 1995. There is a heated debate between environmentalists and the aseptic industry as to the environmental impact of the packaging. Recently the Aseptic Packaging Council launched an extensive publicity campaign about the recyclability of juice boxes. However, some states and localities have banned or are considering banning aseptic packaging because of the difficulty in recycling multi-material packaging.

OBJECTIVE: Students will explore and understand the impact of consumer decisions as they relate to single-serve aseptic packaging. They will research many phases of the life cycle of aseptic packaging including production, transport, marketing and consumption. They will compare this type of packaging to other packaging available. Then in a mock courtroom setting, they will judge whether or not single serve aseptic packaging is environmentally friendly.

BACKGROUND: (See attached.)

ACTIVITIES:

This lesson will involve a mock libel trial brought against Environmentalists by Aseptic Packaging. Your classroom will become a courtroom. The mock trial process is a way for students to explore the American legal system and to develop critical thinking skills. Students will research, prepare cases and participate in all stages leading up to the trial. Students will act as the plaintiffs, defendants, attorneys to represent each side, as well as witnesses, judge and jury. A guide for the teacher outlining some of the pros and cons of aseptic packaging has been included. (See background information.)

Researching the Evidence

Students will research aseptic packaging utilizing various methods including computers, telephone, written correspondence, personal contact, site visitation, etc. A careful effort should be made to avoid duplication of efforts.

Divide students into groups of 3 to 5, depending on class size, to complete the various stages of the research process. These groups will include:

Technology Team: These students will access the various electronic bulletin boards available via modem. (Check with your librarian for computer bulletin boards in your area.) Also, students should be trained and given adequate opportunity to access the various data bases available through the MARMOT or other library systems.

Correspondence Team: These students will write letters to associated manufacturers, producers, supply houses, advocate and action groups (see resources) etc. to gather information.

Telephone Team: These students will utilize the telephone as a means of locating and gathering information at the local level, particularly with distributors and retail market personnel. These students can also utilize 800 numbers to obtain information.

Face to Face Interviews: These students will interview classmates, teachers, parents and community members to acquire relative information, viewpoints, opinions, biases and ideas. Students could create standard questionnaires and poll interviewees.

Consumer Investigators: These students will investigate packaging options at local markets. This information should be graphically represented so as to be available for other research groups and evidence/exhibits. Students should attempt to bring samples of each type of packaging option to class. These may be borrowed from the store through the consumer information specialist or store manager.

Bookworms: These students will conduct library research involving books and periodicals. This may be done following the computer search through the MARMOT System, or other library systems.

Presentation

After the research is completed, instruct all groups to present their findings to the class.

Trial Preparation

Once the initial research has been completed, the students must be assigned their roles for the mock libel trial. Choose the judge, plaintiff (Aseptic Packaging), defendant (Environmentalist), plaintiff's attorney and defendant's attorney. Then choose the jury. The balance of the class can serve as the witness pool, half for the plaintiffs and half for the defendants. Assure that each student has a role.

Discussion About the Court System

Lead the students in a discussion about the U.S. court system. Refer to the material in the background information section if needed. Explain to them the differences between civil and criminal court, prosecutors and plaintiffs.

You may wish to relate any personal courtroom experiences. At this point in the lesson, it is advisable to show a current video with a dramatic courtroom scene, pointing out the various characters and stages of the trial, or take students on a field trip to a real courtroom trial.

Give each student a copy of the "**Courtroom Procedures**" handout. Allow adequate time for the two sides (attorney, witnesses, and plaintiff or defendent) to complete their research and prepare written outlines of their case. During this time ask the judge and members of the jury to research and prepare a report on the importance of their roles in the trial process.

The Trial

On the day of the trial, ask the students to dress up as though they were adults in a courtroom setting. Appropriate attire could include suits, ties, briefcases, dresses and heels. By following the Courtroom Procedure sheet, students will dramatize the trial based on arguments developed as a result of research and discussion.

Classroom Setup

Rearrange the room, as much as possible, to represent a real courtroom. (See diagram.)

At the close of the trial, when the jurors leave the room, ask those students who had roles in the trial process, other than juror, to form a second jury and go through the deliberation process. It is important for the students to be able to step out of their previous roles to alleviate bias. Compare results and significant points of discussion within each group.

EXTENSIONS:

1. Contact the Aseptic Packaging Council about setting up aseptic packaging recycling in your school or town.

2. Perform your mock trial before an audience.

3. Have the students draft a petition, based on fact, defending their point of view regarding aseptic packaging.

BACKGROUND INFORMATION:

Aseptic Packaging

Aseptic Packaging, juice boxes, or brick-packs are all terms which refer to box shaped containers which are manufactured through a laminate construction which combines six layers of paper (70%), polyethylene (24%) and aluminum (6%).(1) This multi-material packaging constituted .18 percent of all containers in 1985 and is expected to rise to 15.1 percent of all containers by 1995.(2) Aseptic packaging is widely used in Europe for a variety of products including, juice, milk, wine, soups, coffee, sauces and many other products.

In the United States, the primary market is the 8.45 ounce juice container. At a growth rate of 20 percent per year in the juice market alone, they are the fastest growing package type on the market.(2) As the use of aseptic packaging increases, readily and easily recyclable bottles and cans are potentially being replaced in the beverage market. The laminate construction makes economic recovery of the paperboard, aluminum and plastic in aseptic packaging difficult. In addition to replacing bottles and cans, single serve drink boxes may also tend to replace reusable containers like thermoses in lunch boxes.

There are two main options for the recycling of aseptic packaging. Hydrapulping is a process which separates the paper from the plastic and aluminum. The quality of the retrieved paper pulp is high due to the lack of inks and the long fiber content. This retrieved pulp is then recycled into other paper products. The second process involves shredding the packages and using the material as filler in plastic wood.

Over three billion units of aseptic packaged product are sold each year in the United States. This results in 35,000 to 80,000 tons of potential waste.(3)

Recyclability is only one environmental factor to be taken into consideration when making a determination on the ultimate impact of a product. The shape of the brick packs increases the efficiency of space in transport. Also, aseptics deliver more liquid with less packaging than bottles or cans of similar product in like sized packages. The materials used to manufacture aseptic packaging are less costly to manufacture than either glass jars or metal cans for comparable products. Furthermore, because product packaged in aseptic packaging does not require refrigeration, total energy cost is reduced.(4)

Aseptic packaging was banned altogether in the state of Maine in 1989. Rhode Island passed a 1988 law which would require all beverage containers to reach a 50 percent recycling rate by 1992. Other states and local governments have also proposed bans on aseptic packaging.

The Court System (5)

The courts belong to the public and are open to everyone. Most people go to court at some time in their lives. Nearly everyone is involved in the court system from birth, because their birth certificates are filed with the court in the county where they were born.

Centuries of tradition and proven problem solving methods have formed the basis of the current court system. Courts have two jobs: (1) to decide what the facts are in a dispute between two parties and (2) to decide what laws to apply to those facts. Every person who goes to court has the right to a fair and impartial hearing. The court must listen carefully to what is said and make a decision based on the facts, not on opinions or prejudices.

There are two types of cases: *criminal and civil.* A criminal case involves people who are charged by the government, through a *prosecutor,* with a violation of a law. Examples are burglary, arson, murder and selling or using illegal drugs.

A civil case is one where there is a disagreement between two people, people and companies, or people and government agencies. Common examples are when a person doesn't think a product has performed as promised and takes a company to court, or when landlords and tenants dispute over rent. Aseptic Packaging v. the Environmentalists is a civil case. The person who brings the case to court to get relief from the other person's actions is called a *plaintiff.* The party against whom the case is brought is the *defendant.*

Any person can be called as a witness in a court case, even at a very young age. However, jurors must be of legal age. Jurors are ordinary people, usually selected from lists of voters or drivers. Persons called for jury duty appear at court on the appointed day. Then the number of names of jurors needed for that day are drawn from a box. The judge explains the case to the prospective jurors. The names of the parties and attorneys are given. If a juror is a friend of one of the parties, he or she could not be fair and impartial and would not be able to sit on the jury. Attorneys from both sides question the jurors to see if they already have opinions about the case. If an attorney feels that a juror would not be fair, he or she can remove any juror from the case. From the remaining pool of jurors, the jury is selected.

COURTROOM PROCEDURES

1. **The Charge** - Aseptic Packaging alleges that, due to the words and actions initiated by The Environmentalists, damage has been done to the character and integrity of the single-serve juice box. The burden of proof lies in the hands of Aseptic Packaging to justify their claims against the Environmentalists.

2. **Opening Statements** - Beginning with the plaintiff's side, each party's attorney makes an opening statement. These statements will represent the position of each side and should outline the facts that each party expects to prove during the trial.

3. **Calling Witnesses** - The plaintiff's attorney will call their witnesses, one at a time. Each witness will raise their right hand and say, "I swear to tell the truth, the whole truth and nothing but the truth." Under *direct examination*, the attorney asks questions of the witnesses which are designed to prove the plaintiff's argument. Following initial questioning, the defendant's attorney has the right to *cross examine*, or question the witnesses to try to prove the defendant's argument.

4. **Defense Witnesses** - After the plaintiff's attorney has called all of his witnesses, the defense may present its witnesses. Again, there is *direct examination* and *cross examination* of each witness.

5. **Closing Statements** - Then the attorney for each party in the case presents a closing argument. Closing arguments should sum up the evidence in a final effort to persuade the jury.

6. **The Judge Instructs the Jury** - "Ladies and gentlemen of the jury. You have now heard all of the evidence. You have heard the testimony of all the witnesses. If you find that the plaintiff, Aseptic Packaging, has proven, beyond a reasonable doubt, that the defendants have caused irreparable damage to the plaintiff by their statements, then you shall find the defendant *'Guilty of the offense of Libel.'* However, if you find that the Plaintiff has failed to prove, beyond a reasonable doubt, that the defendants, The Environmentalists, have caused irreparable damage by their statements, then you shall find them *'Not guilty of the offense of Libel.'* You must reach a fair verdict based on the evidence presented."

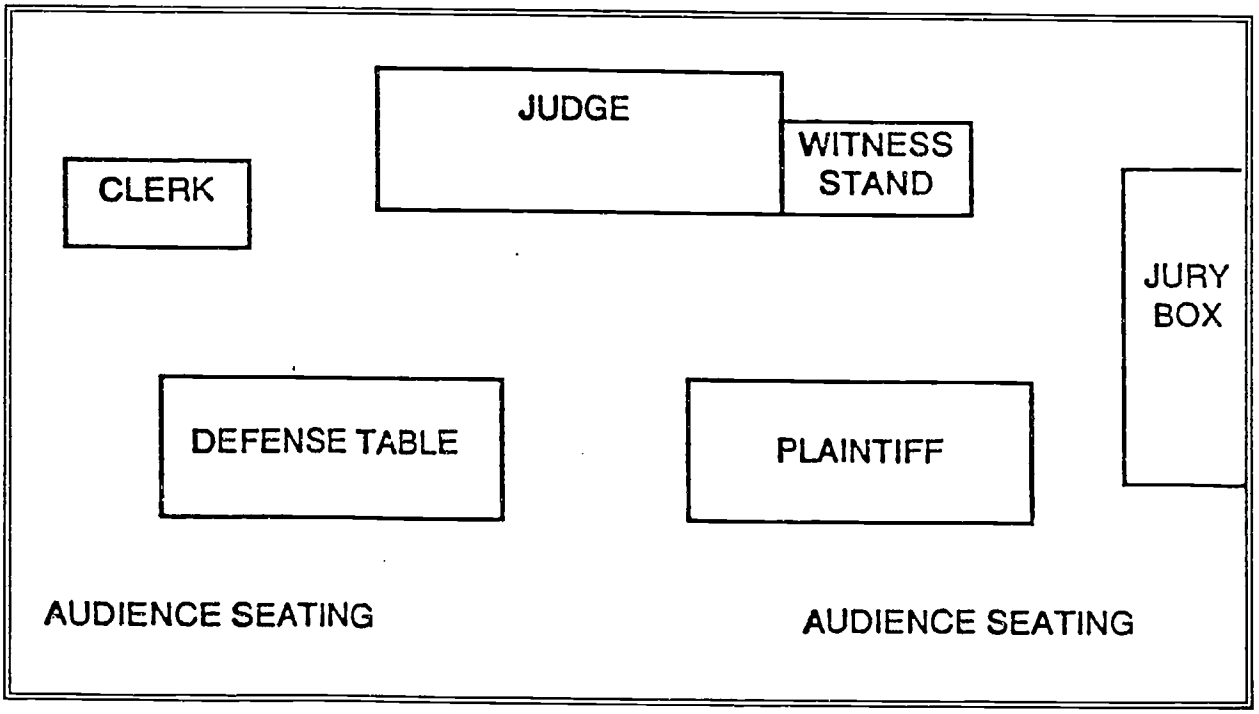
7. **Deliberation** - The judge instructs the jury: "You may now retire and commence your deliberations." The Jurors leave the courtroom. In a civil trial, five of the six, or ten out of the twelve jurors must agree on the verdict.

8. **Verdict** - The "head juror" presents the verdict to the judge who announces it to the courtroom.

TEACHER GUIDE TO ASEPTIC SINGLE SERVE PACKAGING
(**Not for student use.**)

PROS	CONS
- less storage space required than for bottles and cans - no refrigeration required - saves energy - convenient, light-weight - less energy required for manufacturing, warehousing, storage, grocery store displays - longer shelf life	- recyclable in only a few areas with major subsidies from aseptic packaging - high cost per ounce compared to other non-single serve packaging - high amount of packaging compared to other non-single serve methods - when pulp is recycled from aseptic packaging, only 40 percent of the fiber is recovered - displaces easily recyclable bottles and cans - displaces durable reusable products such as thermoses

COURTROOM DIAGRAM



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1. Aseptic Packaging Council. Drink Box Recycling. Washington, D.C.. 1993.

2. The Solid Waste Alternative Project. Solid Waste Action Paper #5." Takona Park, Maryland: Environmental Action Foundation, March, 1991.

3. "Boxing Over Juice Boxes." Fortune. June 3, 1991: 96.

4. Hunter, Beatrice Trum. "The Pros and Cons of Aseptic Packaging." Consumers' Research. August 1991: 15-17.

5. Minnesota State Bar Association. "Courts and Trials and the Trial Process." A Look at Law. 1989.

ADDITIONAL RESOURCES:

1. Aseptic Packaging Council, P.O Box 3794, Washington, D.C. 20007, 1-800-277-8088.

2. Miller, Marvin. You Be the Jury. New York: Scholastic Inc, 1987.

4. Murray, Thomas, R. and Paul V.. CASES-A Resource Guide for Teaching About the Law. Glenview, IL: Scott, Foresman and Company, 1982.

5. Solid Waste Information Clearing House, (SWICH). P.O. Box 7219. Silver Spring, Maryland 20910. SWICH HOTLINE: 1-(800)-67-SWICH.

6. Environmental Protection Agency Regional Office Hotlines:

REGION 1 (Connecticut, Massachusetts, Maine, Vermont, New Hampshire, Rhode Island).
General Number (617)-565-3715

REGION 2 (New Jersey, New York, Puerto Rico, Virgin Islands).
General Number (212)-264-2515

REGION 3 (Delaware, Maryland, Pennsylvania, Virginia, West Virginia, District of Columbia).
General Number (800)-438-2474

REGION 4 (Alabama, Florida, Georgia, Kentucky, Mississippi, North Carolina, South Carolina, Tennessee).
General Number (800)-282-0239

REGION 5 (Illinois, Indiana, Michigan, Minnesota. Ohio, Wisconsin).
General Number (800)-621-8431

REGION 6 (Arkansas, Louisiana, New Mexico, Oklahoma, Texas).
General Number (214)-655-2200

REGION 7 (Iowa, Kansas, Missouri, Nebraska).
General Number (913)-551-7003

REGION 8 (Colorado, Montana, N. Dakota, S. Dakota, Utah, Wyoming).
General Number (800)-759-4372

REGION 9 (Arizona, California, Hawaii, Nevada, American Samoa, Guam, Commonwealth of the Northern Mariana Islands, Republic of Palau, Federated States of Micronesia, The Republic of the Marshall Islands).
General Number (415)-744-1500

REGION 10 (Alaska, Idaho, Oregon, Washington).
General Number (206) 553-5810

CONNECTIONS--Life Cycle Kinesthetic Learning

EVALUATION

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1. What did you like most about these lessons?

2. What did you like least about these lessons?

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